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# REPORT OF THE COMMITTEE APPOINTED BY THE GOVERNMENT OF INDIA TO ENQUIRE INTO THE BOMBAY BACK BAY RECLAMATION SCHEME.

1926

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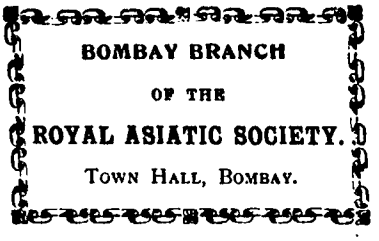


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# REPORT

OF THE

# Committee appointed by the Government of India to enquire into the Bombay Back Bay Reclamation Scheme.

## 1926.

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6, Richmond Terrace,

Whitehall, S.W.1,

1st December, 1926.

SIR,

I am directed by the Chairman and Members of the Committee constituted under the Government of India's resolution No. Mis. 81, dated 29th July, 1926, to submit herewith their Report on the matters remitted to them for inquiry.

I have the honour to be,

Sir,

Your most obedient Servant,

R. B. EWBANK.

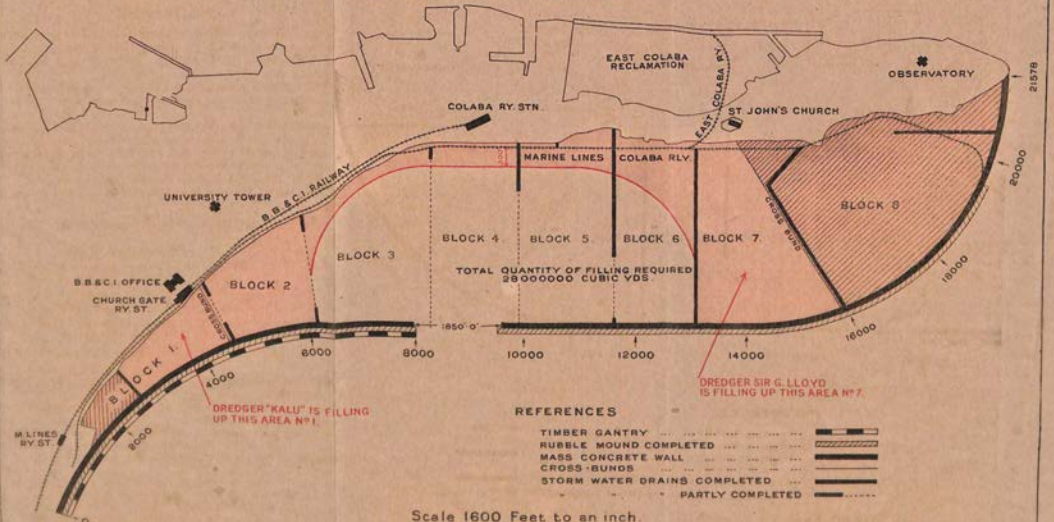
The Secretary to the

Government of India,

Department of Industries and Labour.

# BACK BAY RECLAMATION SCHEME.

## AREAS COLOURED RED SHOW THE EXTENT OF THE RECLAMATION NOW PROPOSED BY THE COMMITTEE.

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# REPORT.

## I.—PRELIMINARY.

On the 19th May, 1926, the Government of India announced their decision to appoint, with the approval of the Secretary of State, a Committee of Inquiry in connection with the Back Bay Reclamation scheme.

2. The following resolution was issued by the Government of India in the Department of Industries and Labour on 29th July, 1926 :—

" At the request of the Bombay Government, the Government of India recently decided, in the exercise of their powers of superintendence, direction and control, and with the approval of the Secretary of State, to appoint a Committee of Inquiry in connection with the Bombay Back Bay Reclamation Scheme.

The Committee has now been constituted and will consist of the following :—

*Chairman:* Sir Grimwood Mears, Chief Justice, Allahabad High Court.

*Members:* Sir M. Visvesvaraya, K.C.I.E., D.Sc., M.I.C.E., Sir Frederick Thomas Hopkinson, K.B.E., M.I.C.E., and Mr. S. B. Billimoria, M.B.E.

The *Secretary* will be Mr. R. B. Ewbank, C.I.E., I.C.S.

The terms of reference of the Committee are as follows :—

*Firstly*, to inquire into the history of the inception and conduct of the Back Bay Reclamation Scheme.

*Secondly*, to make recommendations as regards future operations.

The Committee will meet in Bombay on Monday the 2nd August, 1926."

In pursuance of the above resolution, the Committee held their first public meeting in Bombay on 3rd August, 1926, and between that date and 24th August examined 38 witnesses. They also inspected the site of the Reclamation, the quarry at Kandivli, the dredger (" Sir George Lloyd "), the booster (" Colaba ") and the " Jinga."

The Inquiry was resumed in London on 17th September, 1926, and 19 witnesses were examined. Sittings were concluded on 15th November, 1926.

A list of the witnesses in alphabetical order will be found in Volume II as a preface to the evidence.

The figures in sterling which are put in brackets against figures of Indian currency have been calculated on the basis of the rupee being equal to one shilling and sixpence and give

therefore an approximate figure. The rupee has been subject to great fluctuations between 1912 and 1926—a matter referred to later in this Report.

The bracketed figures are given to enable the significance of the sums to be more readily followed by those familiar with English currency. Rs. 100,000, equal a lakh. 100 lakhs constitute a crore.

3. An attack of malaria prevented Sir Grimwood Mears for a time from continuing to serve on the Committee, and from the 18th August until the 26th September, Sir M. Visvesvaraya occupied the chair.

4. The Report which we are now submitting is a lengthy document, but we feel this to be unavoidable. The matter is one of great public importance, regard being had to the gravity and urgency of the housing question in the City of Bombay, as well as to the magnitude of the sums of money involved. It has excited widespread interest and the reputations of gentlemen of high position, filling a large space in the public eye, must inevitably be affected by the conclusions at which we have arrived. Our endeavour, therefore, has been to produce a self-contained document, affording the public an opportunity of estimating for themselves how far our conclusions are justified.

## II.—HISTORY OF SUCCESSIVE RECLAMATIONS.

5. The importance of the Reclamation which is the subject of our Inquiry cannot properly be appreciated without a brief historical sketch of the circumstances under which Bombay has arisen from a group of seven islands, swamps and encroaching sea to the beautiful city of to-day. Bombay owes everything to successive reclamations. When, in the 16th century, Bombay was a Portuguese possession, land reclaimed was given in perpetuity to those who carried out the undertaking.

Similar encouragements were offered when Bombay came under the control of the East India Company.

It was not, however, until about 1775 that the first work of any magnitude was put in hand, and this resulted in the addition of the Vellard to the city.

Small areas were reclaimed in succeeding years, but it was during the great prosperity of the sixties—an indirect consequence of the American Civil War—that vigorous action was taken. Then came into existence the Apollo Bandar, Frere Reclamation, Mody Bay, Elphinstone, Mazagaon and Tank Bandar.

In 1863 the Back Bay Reclamation Company was formed. Their project was the ambitious, but feasible one, of reclaiming some 1,500 acres of the foreshore of Bombay.

In 1864, the Government of India, at the instance of the Government of Bombay, permitted the company to undertake the work which was proposed to be done by dry filling, that is,

the gradual driving back of the sea by earth dumped upon the foreshore Despite difficulties, the reclamation proceeded and might have been brought to a successful conclusion had it not been for the failure of the Asiatic Banking Corporation, which held upwards of 90 lakhs of the money of the company. This stopped the enterprise, but the partial reclamation which had been effected has been stated in evidence to have been of great permanent value to Bombay.

In 1887, a justified belief in the growing importance of the city of Bombay induced the Government of Lord Reay to order an inquiry with a view to the preparation of a comprehensive scheme for dealing with its future extension in the interests of the health of its population and for the better accommodation of its increasing industries. In considering the question of the reclamation of Back Bay the Committee estimated that this could be achieved—again by dry filling—at a cost of about Rs. 7½ per square yard or at Rs. 9 for net building area. No work was however undertaken.

The subject was revived by the Government of Lord Sandhurst and another Committee was appointed to examine the proposals of the earlier Committee and to advise Government on the steps to be taken and the appropriate agency for improving the City in a comprehensive, reasonably rapid and economical manner. The Committee confined themselves mainly to the steps necessary for the opening out of congested areas in the City and their recommendations resulted ultimately in the creation of the City Improvement Trust. Reclamation was to be left to the Trust who were to decide on the manner and extent to which it should be done. They came to the conclusion that a reclaimed area on the west side of Colaba Point would be an extension of great benefit and would prove remunerative. The work was put in hand, and at the cost of a little over 5 lakhs (£37,500) nearly 90,000 square yards was added to the City. The financial forecast was correct, for the land was speedily taken up at rentals representing a capital value of 24 lakhs (180,000). At this time many other schemes, in actual progress or immediate contemplation, were occupying the attention of the Trust with the result that they made no further attempt to repeat their initial success.

A Military Lands Committee contemplated in 1904 the reclamation of very extensive areas in Back Bay and on the harbour side of Colaba but no actual work was undertaken.

A year later, the Bombay Public Works Department considered the possibility of reclaiming Back Bay and they prepared four alternative schemes.

The proposals were to reclaim areas of 2,294, 1,712, 207 or 200 acres respectively, and it is of importance and interest to notice that for the first time it was proposed to reclaim by dredging from the Harbour and pumping the spoil through pipe lines laid across the City of Bombay.

In 1906 the same Department drew up a revised scheme for the winning of 973 acres from Back Bay and 121 acres from the Harbour side of Colaba Peninsula. They estimated the cost of the Back Bay project at Rs. 3·73 per square yard.

Thereupon Lord Lamington appointed a Committee to consider the scheme, and as a result of certain suggestions made by them it was estimated that the work in Back Bay would cost not 176 lakhs but 320 lakhs (£2,400,000).

6. The feasibility of a successful reclamation of Back Bay attracted in 1908 the attention of Messrs. Lowther and Company, a well-known firm of engineers. They prepared outline schemes of a very ambitious nature; the first being the reclamation of an area of 3,576 acres at an anticipated cost of Rs. 7·10 per square yard and the second a smaller area of 2,945 acres at a slightly lesser cost. They corresponded with the Government of Bombay and in 1910 submitted two other alternative schemes which provided for the enclosure of 1,272 acres at a cost, inclusive of development, of Rs. 5·80 per square yard rising to 6·04 per square yard for a smaller area of 973 acres.

7. On 21st January, 1911, the Government of Bombay addressed the Government of India, emphasising the urgent need for the provision of areas suitable for residential quarters and sites for public purposes and stated that, after extensive consultations with different interested bodies they placed reclamation in Back Bay in the forefront of the programme of urgently needed developments. They submitted the two schemes prepared by Messrs. Lowther and Kidd (the successors to Messrs. Lowther and Company). The first had for its object the reclamation of 973 acres as proposed by the 1907 Committee at a cost of 284½ lakhs, the debt being extinguished at the end of the 69th year. The second scheme provided for the reclamation of 1,272 acres at a cost of 388 lakhs, the debt being extinguished within a century. The Government of Bombay were disposed to consider that the best and most profitable scheme would probably be one having a gross area of about 1,100 acres. The letter gave no details of this scheme, the object being to obtain the approval of the Government of India and the Secretary of State before undertaking its detailed examination. They stated that they were not in favour of granting a concession to a private company to reclaim the land and to lease it for a term of years, on the grounds that such an arrangement would not assist the Improvement Trust; and they were of opinion that a Company could not borrow money except at rates of interest which might jeopardise the success of the scheme or raise the price of the land reclaimed to an excessive figure; and further that Government would be debarred from that control over the operations which they considered essential.

8. To this communication the Government of India sent a cautious reply. They stated that the information furnished was insufficient to enable them to recommend the project to the Secretary of State as a productive work or to accept any responsibility

financial or otherwise—they emphasised that the money required for the scheme would have to be diverted from remunerative railway and irrigation projects and they expressed an opinion, which experience has since justified, that they were not convinced that the carrying out of the work should be entrusted to the departmental agency of Government rather than to private enterprise working under Government control.

They added two observations of great weight that " large estimates of this type were particularly liable to be exceeded and that even in Bombay experience of this type of reclamation on an open sea front was limited ".

9. The Government of Bombay replied on 6th December, 1911, and explained that the two tentative schemes were put forward with the object of proving that the reasons for believing that the work would be reproductive were sufficiently strong to justify expenditure on the more detailed investigation required for the preparation of a complete project. The figures put up by them had been prepared by their own Public Works Department officers and confirmed by Mr. Kidd, who possessed special knowledge of this class of work. The Governor in Council was convinced that the figures had been drawn up with due care and were sufficient for the immediate purpose in view, namely, to show that the reclamation scheme would be a reproductive public work and, as such, deserved detailed investigation. They gave reasons for disapproving the formation of a syndicate to undertake the work, or its transference to the Corporation or to a local Trust, or to a special Reclamation Trust created *ad hoc*. They urged that the work should be undertaken on the financial responsibility, if not by the agency, of Government, loans being raised by the Imperial Government and placed at the disposal of the Local Government, and they made the prudent suggestion that the work should be executed by a contractor under the supervision of a Government engineer. They forwarded an offer from Messrs. Lowther and Kidd to execute and complete a detailed survey and investigation of the site, and to supply detailed drawings and estimates based on such survey. They added that it was not intended that the firm's estimate should be accepted without careful scrutiny on the spot by an independent expert, if such could be obtained. The Government of India agreed to the proposed detailed survey, on the understanding that the expense thereof would be met from provincial revenues and that the Local Government would take such precautions as might be necessary to ensure the correctness of the surveys and reports.

10. On the 18th January, 1912, Mr. Kidd was instructed to make the survey and submit a report. Mr. Kidd was then in London. He proceeded to Bombay and on the 3rd August, 1912, presented his report to the Government of Bombay. The report will have to be dealt with in some detail; but it is sufficient at the moment to say that though he described the work as one of " an exceptionally specialised character," he had a full belief in the feasibility

of the scheme and in his ability to carry it through. In the period between January and July 1912 he took 1,314 borings over an area of about six square miles in the harbour and recorded 1,159 of them. He had complete confidence in the existence of sufficient material of a suitable character and he was satisfied that, with modern suction dredging plant of proper power, the material could be removed from the bed of the sea and pumped across the peninsula into an area of 1,145 acres enclosed by a sea wall.

He described the clay as " stiff and unctuous "—a description which must be referred to again and again. His estimate of the cost, after allowing 20 per cent. for possible increase in the current prices of plant and labour, was 325·23 lakhs (£2,439,225).

On these figures the cost per square yard of the area when reclaimed was Rs. 5·86—about 8*s.* 9½*d.*

11. In submitting this estimate to the Government of India on 7th August, 1912, the Bombay Government observed : " The investigations have been most carefully made and may be accepted as exhaustive. The report is clear and complete ; all doubtful points have been settled, and the revised estimates now forwarded may be accepted as completely trustworthy." They added that His Excellency had the fullest confidence in the ability and expert knowledge of Mr. Kidd, who had worked out the project in detail. In a further letter of the 11th March, 1913, they forwarded the report of a Committee of prominent and representative citizens, appointed under the chairmanship of Sir Vithaldas D. Thackersey, who had been asked to advise on certain specific questions connected with the scheme. The Committee were unanimous in maintaining that reclamation was required to prevent overcrowding and the pressure of increasing rents. They thought that an average sale of 60,000 square yards per annum was a reasonable assumption, and that Rs. 25 per square yard selling price was a safe estimate. They recommended that the work should be undertaken immediately.

12. The Government of India examined these proposals with great care. Members of the Governor-General's Council visited Bombay in the course of 1913 and discussed the matter with Sir George Clarke (Lord Sydenham) and with Lord Willingdon, as well as with a number of prominent people in Bombay. The following decisions were arrived at :—

(1) A strong and representative Committee should consider the reclamation of Back Bay in connection with the general development of Bombay City.

(2) If the Committee were in favour of the Back Bay scheme a beginning should be made with a strip of land measuring 84 acres at an estimated cost of 37 lakhs.

(3) The above sum was to be found from provincial funds and the validity of the estimates and the demand for land was to be decided by this experiment. If it proved successful the profits would be available for another sectional extension.

13. Sir Claude Hill, who comes into prominence later, was the Chairman of the Bombay Development Committee, which was constituted in accordance with the decision just mentioned. They proposed a preliminary reclamation of an area of about 100 acres, mainly to provide for urgently required public buildings. They were of opinion that this work when completed would furnish a practical test of the correctness of the large estimate of 325 lakhs, but they appear to have overlooked the fact that it would not have been a reasonable business proposition to acquire dredgers and dredging plant for this small area and that, if the reclamation was to be done by dry filling, the cost would afford no basis of comparison with the proposed scheme of dredging advocated by Mr. Kidd.

One gathers that this proposed limitation of area did not meet with the approval of the Government of Bombay, who on the 15th September, 1916, put before the Government of India a new proposal of Mr. Kidd to reclaim 220 acres at a cost of 83½ lakhs (£626,250). The Local Government stated that as a matter of caution they had increased the estimate to 124 lakhs (£930,000), whilst extending the time anticipated by Mr. Kidd from 4½ to 8 years. After provision for roads the cost of reclamation was stated to amount to Rs. 15 per square yard. The undertaking was to be financed from Provincial revenues.

14. In February 1917 the Government of India refused their sanction, pointing out that the ordinary expenditure of the Local Government was in excess of their ordinary receipts, but intimating that they might consider a scheme based upon the more modest recommendation of the Bombay Development Committee. Concentration on war activities precluded for a time the further consideration of any scheme.

15. In December 1917 a Syndicate of important and influential citizens interested themselves in the possibilities of reclamation. They were Sir Sassoon David, Sir Shapurji Broacha, Sir Fazalbhoy Currimbhoy, Sir Vithaldas Thakersey and Mr. (now Sir) Lallubhai Samaldas. They asked the Government of Bombay for a concession and proposed to form a company with the necessary capital.

In the same month the wealthy and powerful firm of Messrs. Tata and Company, Ltd., also sought a concession. Within a few weeks the Syndicate and Messrs. Tata and Sons joined forces, and on the 15th January, 1918, their representatives had a meeting with the Hon'ble Mr. Carmichael (now Sir George Carmichael), the Finance Member to the Local Government.

The willingness of the Syndicate and of Messrs. Tata and Sons, Ltd., to undertake the enterprise gave the project fresh impetus. It must have occurred to the Local Government that the readiness of these groups to embark their money and business reputation in the venture fortified their own opinion of its feasibility and ultimate financial success. The reclama-

tion, if undertaken by the Local Government and successfully completed, would ease the congestion in the valuable business and residential area, would provide for open spaces which were urgently needed, and might yield a profit which could be used for the benefit of the poorer classes, whose conditions of life were at that time and are to-day a reproach to the city of Bombay. In the Report of the Bombay Development Committee (1914) it was stated (page 58) that in the census of 1911 " out of the total population of 929,082, living in 200,308 tenements, 743,247, i.e., about 80 per cent. of the total population, live in 166,337 one-room tenements ". Shocking as this condition was in 1911, it became worse in 1917 and accentuated in 1919, by which date the population on a conservative estimate had risen to 1,400,000 with an almost complete absence of any corresponding increase in housing accommodation. In a despatch to the Governor of Bombay dated the 26th October, 1917, Mr. Montagu, the Secretary of State, noted with approval that the Governor of Bombay and the members of the Local Government had impressed upon millowners their obligation to provide for the housing of their operatives. He described the existing conditions as highly unsatisfactory and as calling for immediate and energetic action, and concluded : " The matter is one in which early action appears to be desirable, and I shall be glad to learn your views and those of the Bombay Government at an early date."

16. The salient points which emerge from the summary hitherto given may be thus restated. The proposal that reclamation work on a large scale should be undertaken by means of dredging virtually precluded any experiment on a small scale because of the initial cost of the plant required. The possibility of getting the work done by private enterprise was being held up by the very natural and proper desire of the Government of Bombay to receive for the public benefit a substantial share at any rate in the large profits anticipated as likely to accrue from the successful carrying out of the enterprise on a large scale. The Government of India obviously regarded the financing of such an enterprise out of public funds as an exceedingly difficult matter in the then existing state of public affairs. At the same time all parties were agreed as to the serious and increasing urgency of some action in relief of the housing congestion, and this urgency had particularly impressed itself upon the mind of the ultimate authority—the Secretary of State.

## III.—INCEPTION OF PRESENT SCHEME.

17. By October 1918, the Government of Bombay had decided to obtain the advice of an independent expert, and in a telegram of the 16th October they stated that they considered " a re-examination of Back Bay Reclamation Scheme a matter of special urgency " and asked that the " best qualified man " should be chosen and sent to Bombay.

18. On 9th December, 1918, the Government of Bombay addressed the Government of India, pointing out that the pressure on building land in the City, especially in the neighbourhood of the Fort, had become intense and a rise in the value of land had induced certain business men in Bombay to turn their attention to the larger scheme of reclamation prepared in 1912. They stated that applications for concession rights had been received from the two groups already mentioned and added that an application had also been made on behalf of Messrs Lowther and Griffiths on terms which involved Government carrying the risk. As the orders of the Government of India precluded the Local Government from taking up any large scheme on their own resources, the Local Government were of opinion that the question of allowing the reclamation to be carried out by private enterprise deserved serious consideration. They held that, while the terms proposed should not be such as to discourage any sound offer, at the same time, if the profits were likely to be high, Government, as trustees of the public interest, should secure a share of those profits. The estimates prepared by Mr. Kidd in 1912 were out of date. Apart from the general rise in the rates of material and labour, the higher cost of all dredging and pumping machinery and appliances, the methods used for constructional work of this character, might have so improved since 1912 that the work could be completed within a shorter period than that allowed for in the estimates. They had always recognised that the estimates prepared in 1912 should be scrutinised by an independent expert on the spot before adoption. They therefore desired to have the scheme examined by the best expert obtainable, who should be one with a large experience in harbour and reclamation work, and a knowledge of recent developments in dredging and pumping appliances.

19. The telegram of the 16th October and the above letter were despatched during the governorship of Lord Willingdon.

### Mr. Montagu's Instructions to Sir George Lloyd.

20. Sir George (now Lord) Lloyd arrived in Bombay on the 16th December, 1918.

21. Before his departure for India, Lord Lloyd, in accordance with the usual practice, spent some time at the India Office acquainting himself with the problems which would confront him in the Presidency when he assumed office. It became immediately apparent to him that the one insistent and urgent question which was causing concern alike to Mr. Montagu, the Secretary of State, the Government of India and the Government of Bombay, and provoking questions in the House of Commons and the Legislative Council, was that of improving the housing conditions of the poorer classes in Bombay. Lord Willingdon had made frequent references to the matter in public speeches. It was said, and with truth, that there was no city in

India so densely populated and that the overcrowding in the unventilated, dark, damp and insanitary one-roomed tenements was a standing menace to the health of the community. One effect of these conditions was that infant mortality touched the amazing figure of 60 per cent.

22. We accept unreservedly the statement made by His Excellency Lord Lloyd, when giving evidence before us, as to the obligation he was under to take prompt and decisive steps to ameliorate conditions of life in Bombay; and this is borne out by the Minute of Mr. Montagu of 6th April, 1920, which was produced in evidence by Sir Louis Kershaw and which runs as follows :—

> "I must implore that we do not incur the terrible responsibility of delaying for an hour the Back Bay reclamation. Land trouble in Back Bay is shocking. I charged the Governor on appointment to deal with it urgently. Whatever is done, the reclamation scheme is the most important item and has been scandalously delayed. If, now that Bombay is ready to begin and the Government of India agree, we delay it, we shall be *particeps criminis*. I cannot conceive any scheme of finance which will obviate the need of a dredger. Therefore let us get on with the dredger, already more expensive by delay, and take any measures possible to expedite it."

### Lord Lloyd's Evidence.

23. In his evidence Lord Lloyd gave us a graphic picture of the City. We append a few extracts :—

> "As far as I could I made a personal investigation. Probably I think I am the only Governor who has personally been down all through the slums and seen them for himself, as very few leading Bombay citizens have done, where you find four families living in one room—pitch dark, half a swamp in monsoon times, without any light or air very often —in incredible conditions. At the Census of 1911 it was ascertained that 80 per cent. of the population were living in one-room tenements. The figures affecting four-fifths of the population were, therefore, important. In that first year we had, raging, the cholera epidemic, which is doubtless remembered by the two of your colleagues, Mr. Chairman, who sit on your right. The figures then of mortality ran to about 600 to 700 deaths a day, probably immensely increased by the foul conditions of the city. The estimate of the Municipal Commissioner was that the total shortage of one-roomed tenements was 48,000—you must forgive me if I am giving you figures you have already got—exclusive of 15,000 required to replace insanitary huts and tenements unfit for human habitation."

" The total shortage of 64,000 tenements was almost 30 per cent., I think, of the total number of one-roomed tenements required to house the section of the population living in this type of residence—perhaps residence is too ambitious a word, this type of lodging. Or, to put it in another way, it might be said that over a quarter of a million of the working classes were without proper homes."

" Every section of the population was seriously affected in 1915. The overcrowding of the middle classes was equally intense, and I think, perhaps, none suffered more than the lower middle classes, clerks and so on. I am informed that even to-day there are a very considerable number of people living in temporary hutments in Bombay in a thoroughly insanitary condition, and certainly unsuitable for a town which claims to be, not the second largest city in India, but the second largest city in the whole Empire."

" It was urged by many business people at that time that there was a risk of business leaving Bombay on account of the difficulty and the cost of getting suitable office accommodation. Briefly, then, while the bulk of the population of Bombay City was living, in 1919, and had done so for years before, under conditions which were a menace to public health, and probably dangerous to society, the housing conditions were oppressive to all. I have mentioned the ravages of cholera, and I might have added the more regular scourge of malaria. The congestion in the business area, I have said, was great. The land and the buildings fetched amazing, even ridiculous, prices in some cases owing to speculation. The Rent Act acted as a check for sitting tenants, but the evasion I have spoken of and the consequent oppression were rampant, and the Act could only be a temporary palliative."

" The Indian Infantry Barracks on the Marine Lines were condemned. I visited them personally and they were very rightly condemned. They should have been condemned years before in my judgment. Their condition was a cause of discontent amongst the men, so much so that it was even suggested that discontent might result in disaffection. It was not an ideally peaceful period, as you remember, in 1919, and those matters had to be very gravely considered. In the monsoon the troops living on mud floors had mud very often for several inches, and in some parts of the room I have seen it up to more than that, of wet mud on which to live."

" The point that I want particularly to make is this. The conditions were appalling. Of that there can be no possible question. They had to be remedied. I received those instructions. They had been deferred for years under several Governments; and it seems to me that my Government was

fully justified, and they would have been failing in their duty if they had not taken urgent and courageous steps to try and put an end to so grave a social ill."

24. In their despatch dated 5th March, 1919, the Government of India supported the proposals made by the Local Government in their letter of 9th December, 1918, and recommended that an authoritative opinion on the scheme should be obtained from the best expert available, and the closest possible estimate of its cost framed. They left the choice of the expert to the Secretary of State, but suggested that he should be entirely independent of any of the firms who had applied, or were likely to apply, for the concession, and therefore excluded the firms of Messrs. Lowther and Griffiths, Messrs. Tata and Company and Messrs. Armstrong Whitworth and Company, Ltd., of which Mr. Kidd was then a member. They added that the decision to have the scheme examined by an independent expert did not connote a final decision as to the agency by which the work was to be undertaken and financed.

THE TELEGRAM OF 8TH APRIL, 1919.

25. Charged as Lord Lloyd was to deal speedily with the housing problem, and the reclamation of Back Bay having been accepted as an integral part of any scheme for the betterment of conditions, he sent on the 8th April, 1919, the following telegram to the Secretary of State. As it contains the first mention of Sir George Buchanan as a possible expert we think it advisable to set it out in its entirety.

"*Back Bay Reclamation Scheme.*—Government of India had asked you to send out best expert available to examine and make final report on above. Government of India had also asked us to send all plans to Delhi for transmission to you in order that expert may study them before departure.

"(1) I think this procedure involved unnecessary delay in view of the fact that expert must be here to see conditions just before monsoon breaks as well as after it.

"(2) I have consulted Government of India, and Sir Claude Hill concurs with me in proposing you should send expert out at once to arrive Bombay not later than third week of May.

"(3) All plans and information essential to experts' study now here.

"(4) Lord Sydenham or W. L. Cameron, late Chief Engineer, Bombay, would advise regarding choice of expert.

"(5) Failing your ability to find expert in short time available, my Government would agree to using Sir George Buchanan, whose services would probably be available and whom the Government of India recommend.

" (6) My telegram has been drafted in consultation with the Government of India and is being communicated to them.

" (7) Please telegraph immediately whether expert can be found in time to arrive by middle of May or whether we should proceed with Buchanan."

26. A consideration of that telegram shows that Lord Lloyd, whilst pressing for an expert to arrive before the monsoon, was nevertheless inviting the Secretary of State to nominate and send out any expert acceptable to him. It was only as an alternative that he proposed Sir George Buchanan, who was at that time in India and whose work on the Munitions Board was nearing a conclusion, if not actually concluded. We think we are justified in assuming that the words " whom Government of India recommend " refer to the recommendation of Sir Claude Hill with whom, as the telegram shows, Lord Lloyd had been in consultation. Difficulties arose in England with regard to sending out an expert and on the 26th May a telegram was sent by Lord Lloyd saying that " My Government . . . in view of difficulty of getting Palmer out before October decided to employ Sir George Buchanan who is at present engaged upon the work and will probably after concluding preliminary investigation proceed home to make further inquiries regarding dredging plant and material."

GOVERNMENT OF BOMBAY'S OFFER TO SIR GEORGE BUCHANAN.

27. The negotiations for the employment of Sir George Buchanan in fact commenced on the 7th May, 1919, on which date Lord Lloyd sent a telegram to him at Simla stating that the Government of Bombay wished to secure his services " at once to examine and report upon the Back Bay Reclamation Scheme." Sir George Buchanan accepted the offer by telegram and on the 12th May, in a letter to Lord Lloyd, said :—

" The work is of a kind with which I am familiar, as I designed and carried out the very large river training and land reclamation scheme on the Rangoon river, whilst I was also responsible for initiating all the reclamation works at Basra which have transformed the river front on the Shatt-al-Arab."

He stated that he assumed that the reclamation would be " effected by dredging outside a retaining wall marking the limit of reclamation and depositing inside the wall." In this connection he made the following prudent observations : " In that case one of the principal problems would be to decide on the best type of dredger and whether at the present greatly enhanced price of these machines the scheme would be practicable from the financial point of view." He suggested that " having obtained all local information " he should go home in order to discuss the dredger problem with the various builders who had done work for him

in the past, " as although I can decide on the best type of dredger, I cannot in the present state of the market, put prices upon them."

28. Sir George Buchanan arrived in Bombay on the 19th May, 1919. He got into immediate touch with Mr. Curtis (now Sir George Curtis) and other Government officials, and Mr. Kidd's report with its accompanying plans and sketches was made over to him.

On the 21st May Sir George Buchanan received a letter from Lord Lloyd expressing pleasure that he had consented to undertake the Back Bay Report and noting that he (Lord Lloyd) thought the whole scheme depended upon the mammoth dredger, its cost and when it could be sent out. He concluded by saying that he believed it to be the biggest dredging scheme ever contemplated and as such would, he was sure, interest Sir George.

29. On the 23rd May, 1919, Sir George Buchanan in a letter to His Excellency stated that the sea wall presented no engineering difficulty; but " as I thought would be the case, the crux of the whole scheme lay in the provision and successful working of the dredger or dredgers." In that letter he suggested leaving for England on the 31st May. He added, " In the matter of dredgers, the best in the world are made by one or other of the four firms in the Clyde district, and some years ago I made a tour of Canada and the United States, in the course of which I inspected most of the large dredging plants from the River St. Lawrence to New Orleans on the Mississippi, but I found nothing which came up to our home work. The war may have altered matters, and it is possible I may find we can do better, both as regards price and delivery, in America." This letter is of importance as it indicates that Sir George Buchanan was prepared to go to all dredger builders on the Clyde or to seek in Canada or the United States a dredger of the best design and price.

### Lord Lloyd's Letter of 25th May, 1919.

30. Lord Lloyd replied on the 25th May as follows:—

> " I should wish to leave the date of your departure entirely to your own discretion, and if you think that the inquiries and final Report, which I am asking you to undertake, will be hastened rather than delayed by your getting to England at once, please make your plans accordingly. All I am anxious for is to know as early as possible whether a Back Bay Scheme is feasible and, on present prices, is a desirable enterprise. If not, to abandon it finally and turn our energies into other directions, or, if it is found practicable, to get on with the job without another 10 days' discussion. I shall hope to see you on Wednesday next and discuss the matter fully with you."

Apart from the directness with which he approached the two principal business factors—the practicability of the scheme and

the importance of ruling prices—the letter deserves the most serious consideration as it shows that at this date Lord Lloyd was not in his own mind in any degree committed to a reclamation scheme and that he was prepared at once to abandon it finally, had Sir George Buchanan, in whom he put implicit trust, advised him against it. Indeed, a few days later, on 28th May, he told Sir George Buchanan that " he would give me his entire and absolute confidence and if I said the scheme was impracticable he would turn it down at once and start on something fresh, but once my opinion was given he would refuse to allow any other expert to report and he asked me not to let him down." (Sir George Buchanan's statement, paragraph 34.)

By the 29th May Sir George Buchanan expressed himself as satisfied that " the surveys and borings made by Mr. Kidd are sufficient to enable me to write my report."

TERMS OF REFERENCE TO SIR GEORGE BUCHANAN.

31. The term of reference under which Sir George Buchanan was asked to prepare his Report are set out at the beginning of his Report. Briefly, he was to examine and report upon Mr. Kidd's scheme for the reclamation of 1,145 acres in Back Bay and in particular specifically to advise upon its practicability from an engineering point of view, the suitability of the type of sea wall or alternative suggestions for a better type, the suitability of the proposed method of reclamation by means of dredging or alternative proposals for the same. He was also asked to prepare a revised estimate for the whole scheme giving details showing :—

(*a*) the cost of dredging plant,
(*b*) the cost of dredging,
(*c*) cost of sea wall and plant,
(*d*) cost of moorum filling (i.e., dry filling) and plant required.

In addition he was to put forward a programme of construction with an opinion as to the order in which the work should be executed and the time within which the various sections could be completed—and lastly as regards the Back Bay Reclamation—his views were asked as to whether the entire work should be given out as one complete contract or divided into a number of small contracts and whether it might not be advisable to carry out some items of the project or even the whole of it departmentally.

32. At this point it may not be out of place to consider what were the qualifications of Sir George Buchanan which had caused him to be recommended by the Government of India as mentioned in the telegram of the 8th April, 1919.

Sir George Buchanan was an engineer of many years' experience. He had been employed in the Rangoon River Training Scheme which was completed in 1913, and for this work he

received the honour of Knighthood. Sir Harvey Adamson, who had been at the time of the execution of the works the Lieutenant Governor of Burma, speaking on the 21st March, 1916, at the Institution of Civil Engineers, referred in terms of high appreciation to Sir George Buchanan's work.

In 1915, at the special request of the Secretary of State for India, he proceeded to Mesopotamia—reorganised the port of Basra, and superintended and controlled the operations of suction cutter dredgers across the Hamar Lake—at the Shatt-Al-Arab Bar and other places and received, in 1917, in recognition of his services, the honour of the K.C.I.E. He was also the recipient of a letter from the Government of India, which spoke in high terms of the " valuable services " rendered by him. The letter concluded with this remarkable passage : " The success of our arms in Mesopotamia has been sensibly promoted by your valuable advice, great powers of organization and experience of the conditions of Indian ports."

It is therefore evident that the Government of India regarded Sir George Buchanan not merely as an engineer of ability, but also as a capable administrator and organiser.

### Negotiations with Messrs. Simons & Co., Ltd.

33. Sir George Buchanan arrived in London on the 25th of June, 1919, and became a partner in the firm of P. W. & C. S. Meik of Westminster, who were thereafter known as Meik & Buchanan. In collaboration with Mr. C. S. Meik he prepared his Report. As he had previously stated, one of the most important matters was the selection of a dredger of the best design, and a day or two before the 25th July, 1919, he had an interview with Mr. McMurray, the London representative of Messrs. William Simons & Co., Ltd., of Renfrew, Scotland, dredger builders.

He gave Mr. McMurray a general idea of the sort of dredger which would be required—the nature of work it would have to do in Bombay, and followed up that interview with a letter of the 25th July to the firm in Scotland in which he stated that he had been asked by the Government of Bombay to report on the Back Bay Reclamation Scheme and wanted an estimate accompanied by a plan for the dredging plant required. He referred to his interview with Mr. McMurray, and said they were in general agreement as to the type of plant necessary.

He enclosed plans showing broadly what was required, and set out what he considered to be the main points for consideration, and he added : " I consider the type of dredger most suitable would be that of the ' Jinga ' and ' Kalu,' with all recent improvements and modifications."

34. Now, the " Jinga " and " Kalu " were dredgers which had been employed by the Bombay Port Trust from 1908 to 1913 on what was known as the Sewri Reclamation. We shall have to comment hereafter on the unfortunate and, to us, almost

inexplicable absence of consultation or communication between the Government of Bombay and the Port Trust in connection with the intention to dredge in the harbour, but we must call attention at once to the importance of the reference to these dredgers as coming from Sir George Buchanan. He had completed his local inquiries in Bombay without having learnt of the highly unsatisfactory working output of both the " Kalu " and " Jinga," though their performances were recorded in a Port Trust official document printed in Bombay in 1915, and will be referred to in greater detail later.

35. As regards a test, Sir George Buchanan, writing in London, said : " I shall be satisfied with a test in this country, and your guarantee that the plant will do the work required." As we shall show later, he never obtained that guarantee, nor a guarantee of " minimum capacity of 2,000 cubic yards of clay per hour," for which he also stipulated in the letter.

36. Towards the end of August, 1919, Sir George Buchanan went to Renfrew and discussed the whole matter at a meeting with the proposed builders, and on 12th September, 1919, the Renfrew firm wrote a most carefully considered letter, drafted, undoubtedly, with the view to protect themselves in every possible way. They offered a dredger not guaranteed to do the work required—nor with a minimum capacity of 2,000 cubic yards per hour, but one which " in our opinion may be expected to meet your requirements."

### A Soft Clay Dredger.

37. Then they specified a " ' Simons Cutter Reclamation Dredger ' designed for dredging to depths up to 70 feet below water level and to be capable of discharging at the rate of 2,000 cubic yards of soft clay per hour through a floating pipe line to a distance of 5,000 feet."

The words of importance are " at the rate of " and " soft clay."

38. At a later date in December, 1919, the firm of Meik & Buchanan were inviting interviews and having correspondence with other firms of dredger builders. These will be referred to hereafter, but when Sir George Buchanan presented his Report to the Government of Bombay he appended to it the plans, specifications and tenders of Messrs. Simons & Co. alone, and Messrs. Simons' offer of a dredger designed for soft clay to which we have just referred, appears at two places in the Report, namely, in their letter of 12th September, 1920, and in the " general description " of the vessel at pages 17 and 20.

### Presentation of Report by Sir George Buchanan.

39. The Report is dated " September, 1919," but it does not appear to have been presented to the Government of Bombay until the arrival of Sir George Buchanan in India on 14th

November. Thereafter he was for a week the guest of Lord Lloyd " in order," as Sir George Buchanan says, " to discuss the scheme to the fullest possible extent."

40. Sir George Buchanan was not initiating a new project. He was reporting on a scheme prepared by Mr. Kidd which, both as regards feasibility and price, had been accepted by the Government of Bombay. Further, in March, 1916, the late Mr. R. P. Russell, Secretary to the Government of India in the Public Works Department, had said that Mr. Kidd's estimate of Rs.325.23 lakhs " seems to have been prepared with great care . . . and is probably as reliable as can be expected." He thought there was " every likelihood " as far as could be judged of the work being carried out at its estimated cost of Rs.325 lakhs.

41. In Bombay, Sir George Buchanan's Report was submitted to Sir George Curtis and the Department over which he presided. It was considered by Lord Lloyd himself and, on the 24th November, Sir George Buchanan, in company with the late Mr. Mead, Chief Secretary to the Government of Bombay, went to Delhi and had interviews with Sir Claude Hill, Member in Charge in the Government of India, Sir Sydney Crookshank, Secretary to the Government of India, Public Works Department.

### The varying descriptions of clay.

42. We now come to two outstanding circumstances which were patent on the documents and which, in our opinion, ought to have been queried, discussed and elucidated by everyone whose duty it was to study the documents. The points to which we are going to call attention demand no technical knowledge. They do demand an intelligent and careful study of the documents.

The essence of the whole scheme was the existence in the harbour of sufficient material suitable for reclamation and the procuring of a dredger designed and adapted for that particular material.

According to Mr. Kidd's Report the clay was " stiff." According to Sir George Buchanan the clay was " hard." (Page 9, Report).

Messrs. Simons & Co. (page 17 of Report) offered a dredger designed to give the required output not in stiff or hard clay, but in soft clay.

43. Sir George Buchanan has given us an explanation with which hereafter we deal in detail, but it is one which after the fullest consideration we are unable to accept, and the amazing fact is that no one, either in the Government of Bombay or in the Government of India, engineer or layman, ever noticed this point, which stood out on the documents before them. No one ever asked Sir George Buchanan if a dredger designed for a specified output in soft clay would give an equal result in

" stiff " clay or " hard " clay. No one asked him if these varying descriptions of clay were immaterial, on the theory that the dredger could work in any type of clay with equal speed and facility. The evidence, as will be seen later, is conclusive that a reduced output in material stiffer than soft clay is inevitable, and the success of the whole scheme, as was evident from the Report, hinged on the dredger giving an unvarying output of 2,000 cubic yards per hour for 15 hours a day for 170 days a year.

THE 1912 AND 1919 ESTIMATES.

44. The second point is that the Government of Bombay and the Government of India had each expressed approval of Mr. Kidd's figure of 325.23 lakhs. This was the 1912 pre-war price.

Sir George Buchanan in 1919, when prices of material and plant had risen by about 275 per cent. and of labour by nearly 100 per cent. over the pre-war rates, believed that he could do the work for 367·61—a 10 per cent. increase only on Mr. Kidd's figures of 1912. We have not failed to note that the average sterling exchange value of the rupee rose from 1s. 4d. in 1912-13 to 2s. in 1919-20. But even when full account is taken of this rise in exchange and its effect on the rupee cost of plant purchased in England, it appears to us astonishing that the responsible officers of the Governments of India and of Bombay were not struck by the very slight percentage increase of Sir George Buchanan's estimate over that of Mr. Kidd.

45. The real truth of the matter was that the officials, both in Bombay and Delhi, were largely in the hands of Sir George Buchanan. We do not suggest for one moment that he in the slightest degree intentionally misled them, but they were not able to discuss the matter on anything like an equal footing with him.

46. Between 1912 and 1926 the rupee was subject to great fluctuations. In the year 1912 at the date of Mr. Kidd's Report it averaged 1*s.* 4*d.* and therefore, if the dredging plant, which could certainly not have been purchased in India, had to be paid for in Great Britain, the relative lowness of the rupee compared with the 1919 prices would have meant that far more rupees had to be disbursed at that time than later for an equivalent sum of money in sterling. Sir George Buchanan, in his Report, took the rupee as of the value of 1*s.* 8*d.*, and therefore for purposes of comparison the rupee had appreciated by 25 per cent. At the same time, the reports of Mr. Kidd and Sir George Buchanan were both based on rupee calculations and the cost of plant and material which was to be purchased in India and of the labour which was to be employed there make up a considerable portion of the total estimate. The fact which cannot be controverted is that Sir George Buchanan's estimate of 367·61 lakhs was an under-estimate, and this fact could have been demonstrated in

1919 at Bombay or Delhi by a few simple questions. These were in fact put to Sir George Buchanan in the course of the inquiry, and the dilemma became apparent.

*Sir Grimwood Mears:* I will leave it, if you say you prefer not to answer the question, but I will put it again so that there may be no doubt about it. If your estimate of 367 lakhs in 1919 was a feasible estimate, and the right and correct figure, that means, does it not, that Mr. Kidd's estimate in 1912 ought to have been 146 lakhs. Do you prefer not to answer that question? —*Answer:* I prefer not to answer that question.

*Question:* If the shorthand writer takes that down— *Answer:* I have already said that my estimate upon Mr. Kidd's scheme was 241·90 lakhs.

*Question:* We will have it any way you like. Let us say that 242 lakhs was the bed rock figure of Mr. Kidd's scheme? —*Answer:* That is it, yes.

*Question:* Multiply 242 by $2\frac{1}{2}$ and you get 605. Ought not your estimate to have come out to over 600 lakhs?—*Answer:* No.

*Question:* Why not—two and a half times 242 is 605?— *Answer:* Well, there are the figures, and you can make anything you like of them.

*Sir H. Courthorpe-Munroe:* Have you put to the witness, Sir, whether he accepts the two and a half times rise in the period?

*Chairman:* He says in his own statement two to two and a half, and we have got evidence, Sir Harry, which shows two and three-quarters. Two and a half will do. Yes, he does accept that.

### Sir Sydney Crookshank.

47. In 1919 Sir Sydney Crookshank was the Secretary to the Government of India, Public Works Department.

He had already had a distinguished career. A Royal Engineer by profession, he joined the Public Works Department in 1892, and in 1907 was the Under-Secretary to the Government of the United Provinces. The excellence of his work during the war may be judged by the recognition accorded to him. In addition to military promotion he received the D.S.O., the C.B. and the K.C.M.G.

When in November, 1919, Sir George Buchanan went to Delhi, it was Sir Sydney Crookshank's duty, as the Technical Adviser to the Government of India, to examine and report on Sir George Buchanan's scheme.

Sir Sydney Crookshank had had no previous experience of reclamation upon an open sea front. He had had wide general experience, and, in particular, he had done considerable work in connection with the construction of docks in France.

48. It should, however, be stated that Sir Sydney Crookshank, whilst reporting generally in favour of Sir George Buchanan's scheme, was nevertheless unwilling that the order for the dredger should be given without further expert opinion, and in his Report to the Government of India he stated : " I cannot pronounce on the design or cost of the proposed dredger, and I am not in a position to question Messrs. Simons' merit and figures. In a case of this sort I should prefer, before coming to a decision, to refer to Sir Alexander Gibb and also, perhaps, to Sir Ernest Moir and Sir Brodie Henderson in a consulting capacity." In evidence he asserted that if he had had the execution of the works in his own hands he would not have attempted it without getting opinions from specialists such as he had named. In a later document he took up a still stronger position and wrote a separate memorandum to the Government of India in which he said he wished entirely to dissociate himself from the purchase of the dredger. He was also insistent in his evidence before us that there should have been a guarantee that the dredger would do the work in Bombay, and that the test should have been carried out there.

49. As he was certainly the most important engineer who discussed the scheme with Sir George Buchanan in India, and as his recommendation of the scheme caused it to be supported by the Government of India and put forward to the Secretary of State, it is necessary to give some extracts from his evidence so that an opinion may be formed as to whether the scheme had that careful scrutiny and expert examination which its importance demanded :—

SIR SYDNEY CROOKSHANK'S EVIDENCE.

*Sir Frederick Hopkinson:* May I take it that your position at Simla was that of technical watch-dog for the Government of India on all technical matters connected with such schemes as this?—*Answer:* Yes. They went through my hands as the Technical Secretary to the Government of India.

*Question:* They would not have been accepted by the Government until they had passed your scrutiny?—*Answer:* No. If I had reported adversely on any project it would have been referred back to the Provincial Government.

*Question:* So that you are in a sense responsible for Sir George Buchanan's estimate, inasmuch as you accepted it?—*Answer:* Yes.

*Question:* And you advised the Government of India that it was accepted by you?—*Answer:* Yes.

50. He stated that in his opinion Mr. Kidd's estimate was an " extremely good " one and the figure of 325.23 lakhs reasonable. He was then asked about the rise in prices between 1912 and

1919 and inquiry was made as to how he thought it possible to do in 1919 work for 367.61 lakhs which would, in his opinion, have cost 325.23 lakhs in 1912. He explained, as was the fact, that he advised an increase of 33 lakhs, bringing Sir George Buchanan's figure up to 400 lakhs, and regarded that as sufficient.

51. We had already had evidence which showed that the prices of plant and material had, as a general average, increased by about $2\frac{3}{4}$ times in the period between 1912 and 1919. The following are some answers given by Sir Sydney Crookshank on this part of the case :—

*Sir Grimwood Mears:* If as you have told us you thought that 325 lakhs, that is £2,437,000, was a reasonable estimate of Mr. Kidd's, how could Sir George Buchanan have done the work for anything less than 650 lakhs, or £5,000,000?—*Answer:* Well, on the face of multiplying by 2 in one case and by 3 or more in another he could not.

*Question:* I have only multiplied by 2. I have taken your own figure. Twice 325 is 650. How could Sir George Buchanan have done the work for anything less than 650 lakhs, roughly £5,000,000? He could not, could he?—*Answer:* I can only say in reply to that that I went into these figures with him. He, of course, criticised Messrs. Kidd's figures for dredging and said they were excessive. On going through it with him I came to the conclusion that this estimate of his of 367 lakhs, plus what I have added on myself, would be sufficient to work on.

*Question:* Then you thought on the 28th November, 1919, that the whole of the work as specified by Mr. Kidd could have been done for 400 lakhs?—*Answer:* That is the view I held then as a result of going into the figures of Mr. Kidd's estimate and Mr. Buchanan's estimate.

*Question:* That is £3,000,000?—*Answer:* Yes.

*Question:* Had you seen Sir George Buchanan's Report at this date? Sir George Buchanan's Report is dated September, 1919, and was undoubtedly in the hands of Government in October,* 1919. Had you seen his Report?—*Answer:* I imagine I had.

*Question:* If you had been in consultation with him it would be the basis of your discussion, would it not?—*Answer:* Yes.

*Sir Frederick Hopkinson:* Had you known that the prices of everything to be used in connection with this work would have been trebled, I presume you would not have agreed to the 367 lakhs?—*Answer:* I am not altogether prepared to say so at all.

*Question:* What? Knowing that the prices had been trebled?—*Answer:* I knew they had been doubled.

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* Later Sir George Buchanan explained that he handed the Report to the Government of Bombay when he arrived in November, 1919.

*Question:* Even knowing they were doubled, having approved of Mr. Kidd's estimate, would not you have thought it must be at least 650 lakhs?—*Answer:* No, because I went into Mr. Kidd's estimate with Sir George Buchanan's 1912 estimate, and as a result of that examination I came to the conclusion that *this* (i.e., 367.61 lakhs), plus what I added, was correct. I cannot possibly go back on that, because I did it with a perfectly good intent, and I went into it very carefully and put it forward as an official recommendation.

*Question:* What I am suggesting is that Sir George Buchanan's estimate was quite unreliable and that you, in your official capacity, assented to it?—*Answer:* After going into it, yes. I was not prepared to consider at that time that it was unreliable. Subsequent events have certainly proved it is.

*Question:* Having regard to the fact that you had previously thought Mr. Kidd's estimate of 325 lakhs in 1912 was a very proper one, you surely must have thought that 367 lakhs, when prices had trebled, could not possibly be a proper one?—*Answer:* I cannot say anything further, except, as I say, I went into the thing, and that is the opinion I gave, and I stick to it.

*Sir Grimwood Mears:* May I ask one question on that? *This* is the document from which Sir Frederick was speaking, giving the figures for 1912 and 1919. If you had had that document alone before you, would you have believed that the work could have been done for anything under 650 lakhs?—*Answer:* You mean with all that detail of every description?

*Question:* All the details of the prices for the years between 1912 and 1919. Would not this document alone have shown you that if Mr. Kidd's estimate for 325 lakhs was a good estimate, Sir George Buchanan could not possibly have done it under 700 lakhs?—*Answer:* I must say, on the face of it, that it seems perfectly correct, but I admit I did not go into it in detail to the extent which is referred to there.

52. He was then asked some questions as to the porousness of the rubble mound under the sea wall and his general position was summarised as follows:—

*Sir Grimwood Mears:* But in all these matters you must have been to a very large extent in Sir George Buchanan's hands?

He replied: "In that I had no personal experience on a large scale of any work of that nature, I admit that I was."

53. Having stated in the Report to the Government of India that "the whole project really hinges on the efficiency of the dredger," he was asked whether the whole project did not hinge on the existence of sufficient material suitable in quality to

provide the dredger with work. He thought that that matter "would be wrapped up in the efficiency of the dredger as a whole":—

*Sir Grimwood Mears:* Surely not. Surely they are quite distinct?—*Answer:* Well, in a way.

*Question:* However efficient a dredger is, it cannot dredge unless it has got material to dredge?—*Answer:* No; but then I had to take it more or less for granted that the material was there or available.

*Question:* Did you really have to take it for granted? You were advising the Government of India, were you not?—*Answer:* Yes. . . .

*Question:* Did you have any conversation with Sir George Buchanan as to whether he was quite certain about the quality and quantity of the dredgeable material?—*Answer:* That I cannot remember; but, generally speaking, I have carried away the opinion that the local conditions were favourable.

54. Later he pointed out that he considered Mr. Kidd's Report to be of immense value and that, "as far as the material required was concerned, it was good enough to go on."

Mr. Kidd's Report was available to Sir Sydney Crookshank. If he ever read it, he certainly never noticed that Mr. Kidd spoke of the clay as "stiff," nor did he observe in Sir George Buchanan's Report that Sir George Buchanan described the clay as "hard," and, finally, he did not notice the cautious limitation of the offer of Simons, who tendered for a dredger capable of dealing with "soft clay."

THE GOVERNMENT OF BOMBAY'S LETTER OF 4TH DECEMBER, 1919.

55. On the 4th of December, 1919, after Sir George Buchanan's return to Bombay from Delhi, the Government of Bombay sent an important letter to the Government of India. The following extracts are of interest:—

"Sir George Buchanan has now presented his Report and I am to say that this Government understands that the Government of India are prepared to accord administrative approval. The Governor in Council does not consider it necessary to discuss the 1912 project again. As pointed out by Sir George Buchanan in paragraph 28 of his Report, Messrs. Lowther and Kidd's plans reveal such an unusual absence of detail that it makes an examination of figures extremely difficult from a technical point of view. In the circumstances, the Governor in Council proposes to discard this scheme entirely and to concentrate attention solely upon Sir George Buchanan's own scheme, which includes the same area as that covered by the 1912 project, viz., 1,145 acres.

" On the technical aspect of the new scheme, the Governor in Council offers no opinion. He is fully prepared to accept Sir George Buchanan's carefully considered views on the practicability of the scheme from an engineering point of view, on the type of wall required for the reclamation, and on the method of reclamation.

" The Governor in Council is confident that the Government of India will have little hesitation in accepting Sir George Buchanan's opinion, in view of the fact that opportunity has been afforded to your Department to discuss all technical details with Sir George Buchanan himself. I am to add that the Governor in Council is prepared, in view of a possible increase of rates for labour or materials, to add 10 per cent. to the total of the scheme as estimated by Sir George Buchanan, and the total cost of the project may be roughly taken at Rs. 4 crores for the purposes of finance.'

56. In stating that the Governor in Council offered no opinion on the technical aspect of the scheme Lord Lloyd was acting in accordance with his expressed intention to rely solely, absolutely and finally on Sir George Buchanan.

His reasons for wishing for an early decision were evident. The reclamation of Back Bay had been discussed *ad nauseam*. It has been the subject, as Sir George Buchanan points out, of consideration by numerous committees. It had been from 1887 a matter of ever-recurring interest, and by 1919 the time had arrived for a final decision, either to undertake the scheme or to abandon it.

The letter gave certain figures of estimated cost and realisation of the area when reclaimed, and added that it was " evident that the proposed scheme will be immensely profitable to Government."

" In these circumstances the Governor in Council trusts that the Government of India will have no hesitation in moving the Secretary of State to accord his sanction with the least possible delay. Meanwhile it is of first importance that the scheme should be accepted by the Government of India and sanction given by them to the purchase of dredging plant in anticipation of the Secretary of State's sanction of the whole scheme. It is understood that there is a precedent for this procedure. I am to ask that telegraphic intimation may be given as regards the immediate sanction required to the proposed purchase of the dredging plant, as the offer quoted by Sir George Buchanan is only open for a very short period longer."

CORRESPONDENCE WITH OTHER DREDGER BUILDERS.

57. On the 24th December, after discussion with Lord Lloyd, a cablegram was sent by Sir George Buchanan to his London office asking that tenders should be obtained from various

dredger builders, and thereupon Messrs. Meik and Buchanan approached three firms of dredger builders, Messrs. Fergusson Brothers, Messrs. Fleming and Fergusson, and Messrs. Lobnitz.

The first-named had no vacant berths, and so put forward no tender.

Messrs. Fleming and Fergusson, on the 22nd January, 1920, asked for certain information which appears to have been of a reasonably simple character. The late Mr. C. S. Meik, however, replied, saying that he could not answer the queries offhand and that a copy of their letter was being sent to Sir George Buchanan in India for him to make the necessary inquiries.

This letter would, in the ordinary course, have reached Sir George Buchanan in India some days before he wrote a memorandum for the Government of Bombay about the tenders.

All, in fact, that Fleming and Fergusson wanted to know was—(1) average working output, (2) length of pipe line, (3) head against pump, (4) revolutions and diameter of pump impeller, (5) velocity of material through piping. At all events Mr. Meik could have answered the first three questions and the dredger builders themselves have decided on the fourth and fifth.

Sir George Buchanan, referring to them in his memorandum, said that they "wished for a great deal of information which was not available." Messrs. Fleming and Fergusson therefore dropped out. Messrs. Lobnitz remained. They were disposed of in the memorandum by the following note :—

> "Lobnitz tender £840,000 for two complete dredgers, each of 2,000 cubic yards capacity, and pipe line, one dredger being used for intermediate station.
>
> "I have no details of Messrs. Lobnitz's tender nor is any time for delivery given; but I do not in any case see the necessity for two dredgers and I recommend that Messrs. Simons' tender be accepted."

All in fact that Sir George Buchanan had to go upon was a cable from his firm in London, and it is in our opinion unfortunate that he did not see the excellent specification which Messrs. Lobnitz, a firm of high repute, sent to Messrs. Meik and Buchanan on 19th February, 1920. The dredgers they proposed to build were to be fitted with double stage pumps and actually as regards horse-power they worked out at a less cost than the "Sir George Lloyd." The character of the material was described by Mr. Meik as "soft" clay in a letter to Messrs. Lobnitz of the 22nd January, 1920.

58. On the 14th January, 1920, the firm of Meik and Buchanan were appointed engineers to the scheme, subject to the sanction of the Government of India and the Secretary of State, and on the 21st February, 1920, Lord Lloyd and Sir George Buchanan had a meeting to discuss how best the work could be pushed forward. Sir George Buchanan favoured the construction of part of the sea wall by local contractors so that work could be

commenced in October, 1920. Owing to a subsequent decision to do the whole of the work departmentally the sea wall was not commenced until October, 1921.

### The Order for the Dredger.

59. Sir George Buchanan left Bombay on the 28th February, 1920, and on arrival in London wrote a letter to the Private Secretary to Mr. Montagu. One paragraph of the letter is as follows :—

> " I have had the advantage of discussing the subject fully with the Governor in Council, Bombay, the Government of India and personally with Sir George Lloyd, and if the scheme is sanctioned by the Secretary of State, His Excellency wishes no time to be lost in placing the order for the dredger, as it is necessary for everything to be ready to begin the reclamation as soon as the first section of the wall is finished."

The letter then referred to the tender of Messrs. Simons and Company, Ltd., and said that " acting upon Sir George Lloyd's personal instructions my firm took in tenders from other builders, the result of which was communicated to the Governor in Council when I recommended Messrs. Simons' tender to be accepted."

### Joint Responsibility of Sir John Biles and Sir George Buchanan.

60. On 25th March, 1920, having ascertained that Sir John Biles, the Consulting Naval Architect to the India Office, would, in accordance with the usual practice, decide on the specification and superintend the construction of the dredger and booster, Sir George Buchanan wrote to Lord Lloyd and rightly pressed the point that he must, as Engineer, also have a voice in the matter. Eventually this point was settled by Sir John Biles and Sir George Buchanan assuming joint responsibility for the design of the vessels. The letter concluded : " Meanwhile, time is passing and I am afraid you will be very disappointed at the continued delay in getting the Secretary of State's sanction to the entire scheme, and at this rate it will be almost impossible to have the dredger ready for work by the end of the 1921 monsoon."

### Government of India Despatch.

61. On the 15th April, 1920, the Government of India in a despatch to the Secretary of State said that the scheme had been discussed by their Secretary in the Public Works Department with Sir George Buchanan. " We are convinced that not only is the project one which presents no engineering difficulties, but that its execution can be effected at a cost which will be more than covered by the amount received from the Local Government

from the sale of land not required by them." The Government of India were satisfied that the work could be carried out with the addition of 10 per cent. to Sir George Buchanan's estimate. The despatch concluded by saying, " the work is one which, in our opinion, should be carried out with the least possible delay. It is essential for the development of the City of Bombay, and we are fully satisfied that it is a highly remunerative undertaking. We therefore strongly recommend it for your sanction, and would ask that the order for the dredger may be placed as soon as you have completed your enquiries."

MR. MONTAGU AND SIR GEORGE BUCHANAN.

62. On the 20th of April, 1920, Mr. Montagu gave Sir George Buchanan an interview. Sir George had prepared a memorandum which he handed to the Secretary of State. Extracts from it will be found in para. 59 of Sir George Buchanan's statement. In it he narrated the substance of a conversation he had had with Sir John Steevens then officiating as Director of Stores at the India Office :—

> " I remarked that the most vital matter in connection with the whole scheme was to place the order for the dredger, as if this was not done promptly a whole year's time would be lost, all our plans being made on the assumption that the dredger (which would take a year to build) would arrive in Bombay in time to start operations at the end of the 1921 monsoon."

At the close of the memorandum he said : " It is perhaps a pity that the Back Bay Scheme is involved with so many other projects because taken by itself it must be exceedingly profitable to the Government."

Mr. Montagu, having read and discussed the memorandum, made an endorsement on it stating that Sir George Buchanan had explained " that the project was being held up on account of the order not being placed for the dredger and I direct that the papers be circulated and the case be brought up in Council for final decision on Tuesday next."

That having been done, " Mr. Montagu," says Sir George Buchanan, " talked to me rather freely." He said that he had discussed the Back Bay Scheme with Sir George Lloyd, and he had impressed upon him the necessity of the work and the importance of its being done by Government.

Mr. Montagu said he was whole-heartedly in favour of the project, which had always been most attractive to him.

" I then explained to him my position, viz., that after my scheme had been approved, Sir George Lloyd had asked me whether my firm would be the engineers, as he did not wish the Bombay Public Works Department to have anything to do with the work. I had agreed on behalf of my firm and had

promised to make the carrying out of the work my principal object, if necessary declining works elsewhere, and I had agreed to go out and spend several months every winter in Bombay."

### Sanction to Scheme and to order for Dredger.

63. On the 4th of May, 1920, the Secretary of State in Council approved the scheme for the Reclamation of Back Bay subject to satisfactory financial arrangements, and at the same time sanctioned the placing of the order for the dredging plant, and this decision was communicated to Sir George Buchanan by the Director General of Stores. On the same day Mr. Montagu cabled to the Government of India saying:—"I desire to acknowledge the admirable work of the Government of Bombay in devising scheme, which is conceived on bold lines, and subject to suitable scheme of finance being evolved, I am prepared to accept proposals in principle." Thereupon the order for the dredging plant was placed with Messrs. Simons & Co.

64. On the 14th June, 1920, Sir George Buchanan, Sir John Biles and Mr. West, of the India Office, had a meeting at which they "went over the tender and specification for the dredger."

Sir John Biles was not shown Mr. Kidd's Report, nor did he learn of the character of the clay as described therein, nor, apparently, did he see Sir George Buchanan's Report with the description therein of hard clay.

He worked upon the letter of Messrs. Simons of the 12th September, 1919, and the detailed descriptions which had accompanied that letter, and therefore, from first to last, had no idea that anything more was required than a dredger capable of discharging 2,000 cubic yards per hour of soft clay through the specified length of pipe, dredging, when necessary, down to 70 feet below low-water level.

## Limitation of Area and Depth by Port Trust and Royal Indian Marine.

### Difficulties of Port Trust Dredgers.

65. We have now reached the stage when this long-discussed project was finally sanctioned by the Government of India and the Secretary of State, and the outlay upon a project, expected to be remunerative after its completion in a few years, substantially commenced with the purchase of the dredging plant. Yet the Government of Bombay had already omitted one essential precaution, and this omission was to react detrimentally on the entire scheme.

The reclamation was to be effected by dredging from Bombay Harbour, and no one had ever troubled to ask to whom the bed of the harbour belonged. How the Governor of Bombay came to be so ill-served in this matter passes our comprehension.

There was in existence a body in whom the bed of the sea was vested by Statute. That was the Bombay Port Trust. There was another body seriously interested in any operations affecting Bombay Harbour, namely, the Royal Indian Marine.

One of the matters which has profoundly stirred public opinion is the absence of any consultations with either of those bodies. The Government of Bombay did not put their plans before them and did not attempt to obtain the benefit of the experience of the Port Trust which they had gained in the years 1908 to 1913, during which the " Kalu " and " Jinga " were used by them on the Sewri reclamation.

If in 1920 the scheme had been submitted to these bodies the point as to the right to dredge must at once have arisen.

The Port Trust had had difficulties with the " Kalu " and " Jinga " which were actually referred to in a letter from the Government of Bombay to the Government of India on 6th December, 1911, in which it was stated that Government were well aware that economy in this class of work (i.e., dredging) could be attained only by securing that the suction dredgers and other plant required should be of the best design. " The difficulties which have arisen with the Port Trust dredgers serve as a warning on this point."

The actual output of the dredgers " Kalu " and " Jinga " when working for the Port Trust are given elsewhere in this Report, and make dismal reading.

66. The absence of any official communication between the Government of Bombay and the Port Trust is one of the most regrettable incidents in the whole history of the scheme. Sir George Buchanan did not inquire if there would be any objection to dredging in the harbour, and coming on the scene as he did in 1919 and finding no doubt on this point raised by Mr. Kidd or anyone, we think he was entitled to assume that the Government had the power to dredge.

But on the other point as to the difficulties which the Port Trust had had with their dredgers we do not exonerate him. He had actually incorporated in his Report the extract we have given—" the difficulties which have arisen with the Port Trust dredgers should serve as a warning on this point "—and the passage as to the necessity for the best design of dredger.

He did not inquire from the Port Trust or anyone what were the difficulties. Although he stated in evidence that he had had many conversations with the late Mr. Messent of the Port Trust he admitted that he did not ask him the one question of importance, which was the output which the " Kalu " and " Jinga " had given during their five years' work.

67. Also in his Report he had incorporated a passage which occurred in the same letter, " that the large reclamations being carried out by the Port Trust afford exceptionally good data for estimating work of this kind." Notwithstanding this express

statement of the existence of exceptionally complete data, he certainly never studied it, and in this connection a curious and illuminating circumstance arose when he was giving evidence.

MR. MESSENT'S PUBLICATION.

68. In the earlier part of his examination he said that he was not aware of the official publication of 1915, giving the results of the working of the " Kalu " and " Jinga." A few days later he said he had come across the pamphlet, and as the copy bore Mr. Messent's initials he must have got it from him. His omission to study this document accounts in a great measure for the present partial failure of the scheme.

A few minutes study of this document at any time between 20th May, 1919, and the date of his signing the Report might have led him to very different conclusions.

He would at once have learnt that the " Kalu " and " Jinga," each guaranteed to do 2,000 cubic yards per hour, had averaged 1,126 only, and that the difference between the amount of the material dredged, as ascertained by soundings, and the amount deposited, as ascertained by measurement, showed a diminution of 24·48 per cent.

It might have occurred to him that if the " Sir George Lloyd," also guaranteed for 2,000 cubic yards an hour, gave the same average of 1,126 cubic yards per hour and a loss of 24·48 per cent. of material was also sustained the reclamation of Back Bay would take about twelve years instead of five and would be an unwise adventure.

His preliminary inquiries in Bombay lasted less than a fortnight—a wholly inadequate time, in our opinion, for him to study conditions on the spot.

69. The Port Trust kept silence throughout 1920 and up to 5th March, 1921. They then asserted their rights and later the Royal Indian Marine did the same. The Port Trust took the view that the dredging area proposed approached too near the end of the Ballard mole and breakwater pier and would add enormously to the cost of the foundations of any extensions that might be found to be necessary; while the Royal Indian Marine Authorities were afraid that the anchorage for men of war might be interfered with. The case of both the Port Trust and the Royal Indian Marine was unanswerable, and eventually they restricted the area over which dredging could be permitted and also restricted the depth over a certain area to 35 feet—the " Sir George Lloyd " having been designed to dredge down to 70 feet.

SCHEME BEFORE LEGISLATIVE COUNCIL.

70. Final sanction was given in June, 1920, to the proposed taxation and a bill amending two local Acts was introduced by Lord Lloyd on 3rd August, 1920.

Lord Lloyd on that day announced that the Back Bay Reclamation Scheme and the housing and other development schemes were to be entrusted to a newly created department—the Development Directorate—and he outlined their duties. Its principal activity was to carry out with the assistance of its engineering staff the Back Bay Reclamation Scheme and any other reclamation schemes which might be found necessary in or near Bombay City. . . . . " It will merely do on a wider scale and in a more efficient manner what Government has already been doing, or I should rather say, what Government would have wished to do, but which for lack of personnel and organisation it has not been able to do when confronted with such large and imperative reforms."

71. An outline of the works proposed to be entrusted to the Development Directorate will be found in the " History of the Scheme " in the Appendix. It may be said, however, that collectively they formed a gigantic enterprise involving a contemplated expenditure of 30 million sterling.

72. The Back Bay Reclamation Scheme met with approval in the Legislative Council and Government was congratulated on the courage shown in undertaking it. It could not be expected that a scheme, which it was hoped would give relief in the expensive business and residential area, and thus lower existing rents, would pass altogether without criticism, but we are satisfied that, generally, the citizens of Bombay approved the scheme, and accepted the assurances of Government that it would prove highly lucrative. The Bill was in fact carried through all its stages without one dissentient vote, and it became law before the introduction of the Reforms in January, 1921.

### Estimate of Profit.

73. On the 28th February, 1921, Sir Chimanlal Setalvad who had recently assumed office as General Member, stated in the Legislative Council that " on a very modest estimate the result of the reclamation would be a profit of at least 30 crores of rupees to the City." Taking the rupee at 15 to the £1, that was an estimate of profit of approximately 20 million pounds sterling.

This statement is based on figures said to have been supplied to the General Member by Sir George Curtis, his immediate predecessor in that office. They may be taken as illustrating the belief current at the time, which was a period of great prosperity, that the scheme would at all events prove a highly remunerative undertaking.

### Appointment of Sir Lawless Hepper.

74. Sir Lawless Hepper was appointed Director of the Development Directorate in November, 1920. The firm of Messrs. Meik and Buchanan were appointed engineers to the scheme under an agreement dated the 17th March, 1921.

75. The respective responsibilities of Sir Lawless Hepper and Sir George Buchanan in relation to the work and in relation to each other have been the subject of much discussion.

We have already set out the reasons why Sir George Buchanan was asked to report on Mr. Kidd's scheme, and in addition Lord Lloyd said in his evidence that the choice was a fairly obvious one.

As regards Sir Lawless Hepper, Lord Lloyd said: "Sir Lawless Hepper, if he had not been an engineer and not had various other qualifications which seemed necessary for the task to which he was going to be put, probably would not have been appointed, speaking in general. Sir Lawless Hepper was selected as Director of Development because the success of the development scheme depended, to a very great extent, on the capacity of whoever was appointed at the head. The work, as you know, was of a very exceptional character, and its operations were on a very large scale. We had to combine in our Director a great many different qualities. It was necessary that the Director first of all should have a very close acquaintance with local conditions. We might have got somebody from America or from a great distance, but it would have taken him two or three years in which to learn the local conditions. It was, therefore, considered important that we should get a man who already knew the local conditions. It was very important that he should understand traction and transit problems, because the whole of that island problem (not the whole of it, but a large part of it) is a traction problem. He had these two qualifications in a very high degree. He knew the place intimately. He was acquainted with the traction problem, as you have just pointed out. He had had a distinguished career as a railway engineer, and he was then holding a very important post on a railway, as you have also pointed out. He had been further proved during the war by his work as the Local Controller of Munitions, and he stood, I think I can say, exceptionally high in the estimation of the Government of India, and, what was also of great importance, he stood very high in the estimation of the public of Bombay. We had to raise public loans, and it was very important that the Director of these works should have the confidence of the public from whom we were asking money. The local public, in a narrower sense, had great confidence in him. As a railway agent, as member of the Port Trust and City Improvement Trust, he was very well acquainted with all the local conditions, and combining those four qualifications, he seemed to be almost unique in experience for that particular post. Those were the considerations which led to his appointment. Therefore, to some extent, his engineering, in a general sense, was a qualification—not very specific."

It will be remembered that the Back Bay Reclamation Scheme was only one of several vast enterprises and Sir Lawless Hepper was not and could not have been chosen by reason of any special

knowledge of marine reclamation because he possessed none. Lord Lloyd was speaking principally in reference to the whole group of undertakings comprised within the ambit of the Development Directorate's duties. This answer, however, gives Sir Lawless Hepper's general qualifications for the schemes as a whole.

76. As regards Back Bay, Sir Lawless Hepper appears to have regarded himself as the " administrative head."

He did not consider himself in any degree responsible for the execution of the works. He seems to have thought that to be the concern of Sir George Buchanan and Mr. Lewis.

### Lord Lloyd's view of respective duties of Sir Lawless Hepper and Sir George Buchanan.

77. Lord Lloyd has told us what he conceived to be the position of Sir Lawless Hepper and Messrs. Meik and Buchanan :—

> " Messrs. Meik and Buchanan designed the works and the Director was responsible to Government for ensuring that the works were carried out according to the firm's designs by the Chief Engineer. The programme of work was set forth from time to time by Sir George Buchanan. The relations of Sir George Buchanan and Sir Lawless Hepper to Government might be described in general terms by saying that the former was responsible for the strategy and the latter for the tactics of the scheme . . . . He was the Government watchdog. That was his main function. It was his duty to see that the organisation was working efficiently and economically. Any departure from the technical proposals of Sir George Buchanan or any proposed action in disagreement with the latter would have been referred presumably to Government for their orders. That is about as precisely as I can give you the relations between Sir George Buchanan and the Director of the Development Department."

### The Agreement of March 17th, 1921.

78. The agreement of 17th March, 1921, is a most puzzling document, and we asked Sir Harry Courthope-Munroe, K.C., (who appeared for Sir George Buchanan) to address us on what he conceived to be its true construction.

By Clause 1 the firm of Meik and Buchanan agree to act as the Engineers of the Secretary of State in carrying out the said scheme and in the construction and execution of all works connected therewith " and the firm shall at all times advise and assist the Government of Bombay in all matters relating to the execution of the works and shall supervise the same and undertake and perform all work and duties devolving upon Engineers of large works and in particular :—

> The preparation of working drawings, specifications, schedules of quantities, etc. As regards " work in India " the agreement specified that Sir George Buchanan himself

should visit Bombay in 1921 and every year thereafter when the working season began and should " remain in Bombay for such period during the working season as he or the Government of Bombay may consider necessary to ensure the complete and satisfactory supervision of the works, and shall also if necessary in his own opinion or in the opinion of the Government of Bombay make additional visits during any monsoon."

79. It was pressed upon us that nothing in the foregoing put any responsibility for the actual execution of the works upon Sir George Buchanan, but it was agreed that he was bound to assist and advise the Government of Bombay and bound also completely and satisfactorily to supervise the works.

Notwithstanding that Sir George Buchanan in his letters asserted on four or five occasions that his firm was responsible for the execution of the entire work, we think that that and the more extended phrase to be found at the end of the letter of 3rd June, 1922, meant nothing more than that as Engineers they were so responsible. We can however understand that these letters may have induced Sir Lawless Hepper to believe that Sir George Buchanan had assumed responsibility for the actual execution of the work. The point, however, is not now of practical importance.

80. The argument that they were responsible for the actual execution of the works is based principally upon Clause 3 of the agreement, which says, " A Resident Engineer . . . will be nominated by the Firm and will carry out the details of the works in accordance with the Firm's instructions but subject to the control of the Director of Development," etc.

It was no doubt the duty of the firm to make out a programme and to give all necessary details as to method and type of work necessary. It was no doubt equally the duty of the Resident Engineer to carry out the work in accordance with the firm's instructions. We do not, however, think that clause on a true construction of the agreement made the firm responsible for the due execution of the work. That was the duty of Mr. Lewis and of Sir Lawless Hepper. Sir George Buchanan has pointed out the impossibility of such a responsibility inasmuch as it is conceded that he had not the power to dismiss or suspend the Resident Engineer who was in direct contractual relationship with the Bombay Government nor had he any power of dismissal over any of the staff of any grade whatever.

81. We are therefore of opinion that Lord Lloyd rightly described the respective functions of Sir Lawless Hepper and Sir George Buchanan, and their duties may be summarised by saying that apart from the specific acts set out in the agreement, Sir George Buchanan has to assist and advise the Government of Bombay and to supervise completely and satisfactorily the execution of the works, according to the usual practice of engineers.

The Resident Engineer had to carry out the details of the works as indicated to him by the firm, and on Sir Lawless Hepper rested the duty of seeing that the work was done efficiently and economically, the Resident Engineer being, by the very terms of the agreement, under his control.

82. We may at this point anticipate events and say that in our opinion Sir George Buchanan did not sufficiently assist and advise the Government of Bombay, nor did he completely or satisfactorily supervise the work. As regards Sir Lawless Hepper, he did not regard himself as responsible for the execution of the work and appears to have thought that the practical carrying out of the scheme was a matter for the Resident Engineer and the firm of Meik and Buchanan, and therefore in practice there was no driving force behind Mr. Lewis, the Resident Engineer, and no effective daily control.

### Sir George Buchanan's Report.

83. Before dealing with the manner in which the work was carried out we ought to give a short summary of the principal points in Sir George Buchanan's report of 1919, as that is a document of prime importance in the case. It will be found appended to this Report.

Sir George was reporting on Mr. Kidd's scheme of 1912 and there is no doubt from what has been already set out that he was desired to report with the least possible delay.

On the question of the nature and extent of dredgable material in the harbour he accepted the opinion of Mr. Kidd.

" On the assumption," he says, " that Mr. Kidd's surveys and borings are correct and I see no reason to doubt their accuracy as a great many borings were taken, I accept his conclusion both in respect to quality and quantity of material " (Report, page 11).

He also accepted Mr. Kidd's opinion that Back Bay itself was not a suitable place for dredging owing to its being shallow, rocky and subject to strong tides.

In the terms of reference he had been asked to advise on the suitability of the proposed method of reclamation by means of dredging or alternative proposals for the same.

84. Whilst we are of opinion that, generally speaking, and with normal ruling prices, reclamation, when undertaken on a large scale, is more economically effected by suction dredging, it was, nevertheless, part of Sir George Buchanan's duty to investigate the alternative method of dry filling. This duty was the more insistent because of the enormously increased cost of dredgers and dredging apparatus since the date of Mr. Kidd's report. Investigation might have revealed the impossibility of getting material in sufficient quantity, with easy access to a railway, and also the railways with their suburban and other traffic might have found it impossible to deliver

the material in sufficient quantity. Also at the time considerable railway reconstruction was in progress. Sir George Buchanan, however, did not consider any other scheme than that of dredging, and dismisses the alternative method by saying that "there is an abundance of material in the harbour for the filling, and it can be deposited in the area to be reclaimed by means of modern suction dredgers much cheaper than in any other way."

85. He calculated that 25 million cubic yards of dredged filling would be required, and he said that this would be accomplished by the plant which had "been designed to deal with 25 million cubic yards in five years, working 170 days a year and 15 hours pumping-time a day in two shifts" thus totalling 5,100,000 cubic yards per working season. This shows a margin of 100,000 cubic yards only, and, therefore, an insignificant diminution in hourly output below 2,000 yards, or a failure to pump for 15 hours throughout the whole 170 days, or a breakdown, meant a falling behind in the programme. Nevertheless, Sir George Buchanan described this dredging output as a "conservative estimate," but, as will be seen hereafter, the dredging operations failed to an almost incredible extent, yielding a result in three years' operation of less than the anticipated output of one year.

### Nomination of Mr. Lewis as Resident Engineer.

86. He urged the employment of a resident engineer, who should be "a specialist in sea works and dredging," and, he eventually nominated Mr. Lewis. We are of opinion that he was not a specialist in sea works or dredging, and our warrant for that is the record of his own career as given by him to us in evidence. Sir George Buchanan, whilst deprecating (Report, para. 44) the employment of any Public Works Department man, on the ground that the Department had no specialists, nevertheless put forward Mr. Lewis, a man from that Department. He had been associated with Sir George Buchanan in the Rangoon River Training Works, but the nature of that undertaking and Mr. Lewis's particular employment thereon certainly afforded no justification for regarding him as "a specialist in sea works and dredging."

It was essential that the resident engineer should not only have the necessary knowledge and experience, but equally essential that he should have energy, driving force, the ability to look ahead and a talent for organisation. We cannot estimate precisely the original fitness of Mr. Lewis for the post, because he has been ill almost continuously since 1922, and was a man in most broken health when he appeared before us.

His failure was no doubt in great part due to his oncoming illness, but at the same time we cannot understand how Sir George Buchanan ever recommended him. It was certainly no task for a man whose experience had been confined

to the work of which he spoke to us in detail, even though he was a man who had risen to a position of eminence in the Public Works Department. In our opinion Sir George Buchanan failed to appreciate the complexity of the work, and he ought to have insisted on the post being publicly advertised and a salary attached to it of a sufficiently substantial character to attract a first-rate man of energy and specialised experience.

If no such man was likely to be procurable, then Sir George Buchanan should have taken that into consideration when writing his report and should have laid stress upon it. Mr. Kidd described dredging on an exposed seafront as " one of the most difficult, expensive and uncertain operations imaginable in engineering," and this unhappy story that we are unfolding fully bears this out.

Apart from Mr. Lewis's condition of health and lack of experience, there was another circumstance which gravely handicapped him. It became necessary for him to prepare a detailed project estimate, and this work we are satisfied occupied him for many hours a day down to May, 1922. He was chained to his desk whereas in fact he ought to have been free to go at all hours of the day to all parts of the work and co-ordinate each part and push it forward. In that way and in that alone could proper progress be achieved. The office demands were however insistent and could not be disregarded, and as a consequence in whatever direction one turns, there is found either failure of organisation, unexplained delays and absence of co-ordination, a wasteful method of work or the acquisition of unsuitable plant.

87. Mr. Lewis spent some part of July and August, 1919, in London at the offices of Meik & Buchanan preparing estimates of plant required, and about £350,000 worth of plant was ordered, apart from the dredger, booster, pipelines and marine appliances.

88. Almost as soon as Mr. Lewis returned to India in the autumn of 1920, it became evident that an expenditure far in excess of Rs. 367·61 lakhs was inevitable, and in July, 1921, in reply to a representation by the Indian Merchants Chamber, Government put forward a figure of 7 crores as the estimated cost of the Reclamation.

### Lord Lloyd and the Indian Merchants' Chamber.

89. On 9th August, 1921, His Excellency Lord Lloyd addressed the Indian Merchants Chamber and told them that he was sure that the more they knew the more they would share his confidence in the enterprise that Government had undertaken for the safeguarding of the trade of Bombay and for the social amelioration of the workers in that ever growing city. He pointed out that it was on the specific request of the citizens of Bombay that the Government were dealing with these questions and that immediately upon his landing he was asked to deal with this question as an urgent matter. He then referred to the

" splendid support of Bombay to the loan issue " and to the unanimous vote of the Legislative Council to the formulated scheme.

He said that " the more my colleagues and I examined the scheme the more convinced were we in the soundness of the project itself, of its essentiality to the future of Bombay trade, and to its necessity for the solution of the housing problem as a whole. I believe that if we are really to cure the great evils of congestion, then we have got to face and undertake the Back Bay Scheme."

As regards expert opinion, he explained the position of his Government in much the same way as in his evidence before us, he described his own position, namely, that having consulted the best experts, the Government should stand by their advice.

He gave the figure of 850 lakhs as the estimated cost of the Reclamation and showed that after deducting roads and allowing 187 acres for open spaces, there would remain 453 acres reclaimed at a cost of Rs. 28 per square yard.

### Detailed Project Estimate of 702 lakhs.

90. Meanwhile, Mr. Lewis proceeded with his project estimate, and in February, 1922, Sir George Buchanan revised his own figures and at that date estimated that the work would cost 668·89 lakhs. He says that the rise in the price of materials, plant and labour between September, 1920, and February, 1922, accounts for the difference. We are not able to agree with him.

We may take one illustration. The Public Works Department in 1912 had given Mr. Kidd a figure of 59·45 lakhs (about £445,875) for " Roads, lighting and drains ".

Sir George Buchanan did not ask the Public Works Department for a revised figure in 1919, nor did he get a copy of the original Public Works Department estimate, and therefore did not know what it contained. All that he did was to increase the 59·45 lakhs to an arbitrary figure of 75 lakhs, forgetful, apparently, that there was a rise of at least 250 per cent. in plant material and labour collectively, between 1912 and 1919. In his draft revised estimate of February, 1922, he re-inserted the figure of 75 lakhs, but in consequence of a conversation with Sir Lawless Hepper about storm water drains he added 60 lakhs (£450,000). In fact the storm water drains will cost £482,000, a sum almost exhausting for this one item, the original 75 lakhs of Sir George Buchanan's estimate for roads, lights and drains.

91. Mr. Lewis eventually estimated the cost of the work to be 702 lakhs. Sir George Buchanan has criticised this figure. We find it difficult to appreciate why he has done so. Mr. Lewis's estimate is after all only 5 per cent. in excess of Sir George Buchanan's own figure of 668 lakhs.

The revised estimate of 702 lakhs was incorporated into the Budget of 1922-1923 and sanctioned. In the Report of the Advisory Committee a calculation based on the then experience

gave the estimated cost of completing the work at 1,102 lakhs (£8,265,000). Mr. Elgee the present Chief Engineer's estimate is 1,000 lakhs (£7,500,000).

92. A careful reading of the Report shows that Sir George Buchanan did not disclose that there were any elements in the undertaking which might cause difficulty. He gave no hint either in the Report or in any conversations with Lord Lloyd or the Member in Charge that there were any factors which might operate against all the work passing through all its stages with precision.

When at the end of the first season it was found that the dredging operations had failed lamentably, Sir George Buchanan explained that the first season's working might be regarded as " experimental ". When it was found that the rubble mound beneath the seawall continued to be porous he appears to have taken the view that the dredged material, silt or mud, which was of so fine a character as to escape through the rubble mound would not make good reclamation material and was apparently content to allow the leakage to continue. Nor did he make mention of the fallibility of the human element—i.e., the lack of skill, energy and zeal of any crew, which he has emphasised so much in his evidence.

93. The work was therefore put in hand by the Government of Bombay in full reliance upon the Report of Sir George Buchanan, and in the fullest belief that all his anticipations would be realised.

## IV.—THE CONDUCT OF THE WORKS.

### The Quarry.

94. The first necessity was to open a quarry. This was done at Kandivli, a distance of about 20 miles from the site of the proposed reclamation.

The more important plant, consisting of railway wagons, locomotives, steam shovels, etc., cost about £350,000.

Originally Sir G. Buchanan estimated that 800 tons of stone a day from the quarry would suffice for the contruction of the sea wall in four years. This amount was subsequently increased to 2,000 tons a day when the decision was taken to build the sea wall from both ends.

A Bucyrus Steam Shovel was purchased for about £9,000 and also three Whittaker shovels at a cost of about £3,000 each. Not one of these machines ever did one day's work as steam shovels, owing mainly to the fact that the quarry did not present a suitable " face " for them and also because no one could be found who was able to work them.

Some of them have been used as cranes, but their original purchase was to a considerable extent a waste of public money.

Before the Bucyrus Shovel was purchased, a cable was sent by the Government of Bombay to the India Office asking for Sir George Buchanan's opinion on its suitability, and on the 13th April, 1920, the India Office cabled that Sir George stated that the shovel would be "very useful for Back Bay Scheme". It was bought. Sir George Buchanan stated in his evidence that it was in fact unsuitable for the work.

95. He however expressed marked disapproval of the purchase of other plant of which the three Whittaker shovels formed a part, and in a letter of 11th April, 1922, he warned the Development Directorate that "in addition to the actual capital cost of the plant interest for many years has to be paid and it is desirable to economise wherever it is possible to do so without interfering with efficiency or with the speedy execution." Sir Lawless Hepper and Mr. Lewis however decided that the bulk of this plant was necessary.

96. With the exception of the matters to which we have referred, the work at the quarry has proceeded more satisfactorily and more smoothly than in any other part of the undertaking.

## Sea Wall.

97. The two main features of the work were the construction of a retaining sea wall on a rubble mound from Colaba to Marine Lines of a length of about 4½ miles and the dredging of material from the harbour by means of a rotary cutter suction dredger which, having displaced the mud or clay from the bed of the sea, would pump it to a distance of 5,000 feet. Its further propulsion to a second distance of 5,000 into the landward side of the sea wall was to be attained by another pumping apparatus—described as a booster.

Mr. Kidd in 1912 estimated its cost at 64·22 lakhs (£428,133, taking the rupee as it stood at 1s. 4d.). Sir George Buchanan was of opinion that the work could have been done for 56 lakhs by Mr. Kidd. His 1919 estimate was 118·11 lakhs (approximately £787,400 taking the rupee at the rate of Rs. 15 to the £ or £984,250 taking the rupee as it stood in 1919 at R. 12 to £1).

The initial object of the sea wall and rubble mound was of course to retain the material pumped into it and the whole enclosed area of 1,145 acres was to be subdivided into eight Blocks by means of cross bunds run out from the foreshore and meeting the wall at right angles, thus creating eight relatively small enclosed areas or lagoons. Block 1 was the nearest to Marine Lines. Block 8 was at the Colaba end. Where storm water drains were necessary they had also to be built and carried through the sea wall. Originally Sir George Buchanan had intended to begin the sea wall at the Marine Lines end and to construct it gradually, keeping it just in advance of the dredging.

DECISION TO BEGIN WALL AT BOTH ENDS SIMULTANEOUSLY.

98. On the 7th July, 1920, the India Office sent a letter to Sir George Buchanan saying that the Government of Bombay wished to have his opinion as to whether it would be possible to begin work on the Back Bay scheme at both ends simultaneously. The underlying reason for this inquiry was that the Military Authorities had undertaken to buy an area of 265 acres at the Colaba end and therefore wanted that part of the reclamation pushed on, it having been Sir George Buchanan's intention to commence at the Marine Lines end and build towards Colaba.

On 10th July the firm of Meik and Buchanan replied suggesting the text of the cable to be sent to the Government of Bombay : " Buchanan reports that it is practicable to begin work on the Back Bay scheme at both ends simultaneously . . . . To begin building the wall in two places will not materially advance matters unless reclamation can also be proceeded with and Buchanan is considering whether the new dredger (i.e., " Sir George Lloyd ") and the " Jinga " (sic., but " Kalu " meant) can work simultaneously at eastern and western areas. Buchanan understands Lewis is on his way home and he will discuss all these points fully with him."

On the 15th July, 1920, Messrs. Meik and Buchanan suggested a further message : " Buchanan has now satisfied himself that the dredger " Jinga " (sic. " Kalu " meant) and the new dredger can work together on Bombay Reclamation and therefore work on construction of the wall can proceed from both ends simultaneously. Buchanan asks for very early orders as to whether he is to proceed on these lines as considerable changes in designs and arrangements for execution of work will be necessary."

On the 29th July, 1920, the Government of Bombay cabled " Work may start from both ends."

99. This was a disastrous decision. It has been put forward that if it was necessary to reclaim the Colaba end first it was prudent to begin the wall at both ends because at Marine Lines the railway was already in existence. At this date, July, 1920, no work of any kind had been done and in our opinion the proper course would have been to construct the temporary line from Marine Lines to Colaba (which had eventually in any case to be built) and to commence the building of the wall from Colaba end only.

In any private business enterprise the offer of the Military authorities would have come as a godsend and everything else would have been subordinated to the acquisition of the purchase price at the earliest possible moment. The purchase price of 256 lakhs (£1,920,000) would have paid for the whole of the dredging plant and all other plant, and that part of the sea wall necessary to enclose Block 8 with storm water drains and crossbund. It would have put the enterprise on a sound financial basis. The

expediency of concentrating upon Block 8 to the exclusion of everything else was so elementary that it is amazing to us that no intensive effort was made to construct the railway from Marine Lines to Colaba—to push on with the necessary length of sea wall, storm water drains and crossbund and thus have at the very earliest moment an enclosed area for the pumping operations.

Construction on both ends of the sea wall was carried out until a gap of 1850 feet alone remained. The cost up to date exceeds 200 lakhs (about £1,500,000). No portion of it at present is giving any financial return and more than three fourths of it is serving no useful purpose whatever. The yearly loss of interest alone comes to at least £90,000 a year.

### Leakage of pumped material.

100. When pumping did at last commence into Block 8 it was at once noticed that large quantities of silt or mud were escaping through the rubble mound into the open sea. Sir George Buchanan has told us that a large amount was escaping through a hole in the wall which marked the passage of a storm water drain. In that particular instance it may be so, but the fact is proved beyond doubt that the rubble mound was porous and calculations have been made which show that in the first two seasons about 900,000 cubic yards of material was lost. This is necessarily an approximate figure. It is arrived at by a calculation of the amount dredged and the amount found on measurement at the end of the season to have been deposited in the Reclamation. We are at least certain that there was a continuous leakage of an enormous amount of material through the rubble mound.

101. If we assume it to be even two-thirds of 900,000 cubic yards and taking Sir George Buchanan's original under-estimate of 8 annas per cubic yard of reclamation the money loss (apart from loss of time) comes to £22,500. Sir Lawless Hepper, Mr. Lewis and Mr. Elgee have all given evidence as to the continuous loss of material and have said that they urged Sir George Buchanan to agree to the sealing of the inner side of the sea wall and the cross bunds by moorum filling. For some reason not very clearly put forward, Sir George Buchanan was not willing that this should be done and indeed he had written on the 3rd June, 1922, to Mr. Lewis, saying, " in any case the sea must pass through the porous rubble wall for a long time to come." There is no doubt that Sir George Buchanan was considerably disturbed as to the character of the silt and mud which was being pumped into the reclaimed area and his inaction may have been due to a belief that the material would never dry out and make good land. At all events, in February, 1925, Sir Lawless Hepper obtained the consent of the Local Government to incur the necessary expenditure and then sealed the wall and cross bund with a sufficient layer of moorum to effect retention of all material pumped into it.

Sir George Buchanan does not appear to have known that this was done, because on the 15th October, 1925, the following passage occurs in a letter from his firm to the Secretary to the Government of Bombay :—

> " According to the figures given in your letter under reply, 1,261,986 cubic yards of material was dredged from the harbour during the last season, but only 680,438 cubic yards was deposited in Back Bay. The smallness of this latter figure obviously points to a great leakage from the area under reclamation, and the advisability is indicated of tipping a water-tight moorum bank along the inside face of the sea wall and otherwise arranging for the detention within the area under reclamation of as much as possible of the silt-laden water discharged through the pipe line until the silt has precipitated."

101. A comparison of Mr. Kidd's estimate with that of Sir George Buchanan shows that Mr. Kidd realised the necessity of using a considerable quantity of moorum as a sealing agency, and his evidence shows that he never contemplated the escape of any dredged material. Sir George Buchanan, whilst not denying the loss of material, took up a curiously detached attitude about it. He seemed in this instance, as in many others to which we shall have to refer, to have overlooked the position he occupied in relation to the works and the Government of Bombay. It was his duty to advise and to assist and to supervise.

Sir George Buchanan has said that he does not think the sea wall was built according to his specification but he did not put that forward when Sir Lawless Hepper and Mr. Lewis and subsequently Mr. Elgee wanted to seal the wall. The point of importance is not so much the fact that the rubble mound continued to be porous, as that Sir George Buchanan did not advise its immediate sealing and did not in the course of his supervision see that it was done. It will be noticed that even as late as October, 1925, his firm when told of the great loss which had occurred contented themselves with saying merely that the " advisability is indicated of tipping a water tight moorum bank along the inside face of the sea wall ".

102. We are of opinion that it was his plain duty himself to have advised immediate action when the rubble mound was found to be porous, and he cannot shift the responsibility for the continuing loss by saying that if it was noticed to be escaping day by day the Chief Engineer ought to have stopped it. Under his duty of supervision his further obligation undoubtedly was himself to require the rubble mound to be sealed when it was found to be non-retaining.

### The Dredgers, Dredging Plant, their Cost and their Operations.

103. At first the work was intended to be done by one dredger (" Sir George Lloyd ") and by one booster (the " Colaba ").

Sir George Buchanan estimated that the combined efforts of these two vessels would deliver through a pipe line 2,000 cubic yards per pumping hour of material dredged from the harbour to a maximum distance of 10,000 feet.

Accepting for the moment (though it is not the fact) that the maximum distance was not more than 10,000 feet and that the whole of the work proceeded with precision, it was no doubt as a mathematical calculation possible to complete the reclamation as regards dredged material in five years.

104. A map is appended to this Report which shows that the radius of operation of the " Sir George Lloyd " and " Colaba " jointly was insufficient to reclaim a large portion of the total area.

It is no doubt true that the provision of another intermediate pumping station would have carried the dredged material to any desired point, but Sir George Buchanan in his Report made no mention of the necessity, for such it was, of a second booster or land pumping station. With the plant as originally specified the reclamation could not possibly have been done.

Under ordinary working conditions, especially having regard to the nature and varying depth of the material in the harbour, and the capacity of the dredger, it was and is impossible to get any output approaching 5,000,000 cubic yards in the working season.

105. The order for the dredger and the booster having been given in May, 1920, Messrs. Simons & Co. put the work in hand and she underwent her tests on 21st November, 1921, and subsequent days.

106. Inquiry was made of Sir John Biles to ascertain whether he checked the accuracy of the information given by Sir George Buchanan or went into the question of the suitability of the dredging plant which Sir George Buchanan wanted. He told the Committee that he was supplied with Messrs. Simons & Co.'s letter of 12th September, 1919, and the documents enclosed therewith and that he worked on them. " The dredger I was told to design was described in the letter of Messrs. Simons and I went ahead and did it. . . . The only thing that guided me was the outline specification supplied by Messrs. Simons. . . . I was to look after the construction of the dredger and he (Sir George Buchanan) was to have the opportunity of seeing whether the dredger that we were producing was what he wanted." Sir John Biles' case, as he presented it to us, was that he was told to design a dredger for " soft clay," and he did prepare a sufficient design and a perfectly good dredger was built from his design which was in all respects up to its work.

TEST OF DREDGER " SIR GEORGE LLOYD."

107. Messrs. Simons & Co. had made a test on the Clyde a condition of the contract, and Sir John Biles passed her both as regards pumping capacity, speed and general construction.

She was not tested under ordinary working conditions, that is to say, she did not pump spoil through 5,000 feet of pipe line. She in fact pumped the dredged material through a short length of pipe running astern, and from pressure calculations when subsequently pumping water it was assumed that she would give her guaranteed output at site. The first point of importance is that the material was not clay, it was a " black clayey silt," and a suggestion has been made that it really did not require cutting because in other trials of other dredgers it had been frequently displaced from the bed of the Clyde. On the other hand it was said that the area over which trials of dredgers take place on the Clyde is a large one and there was no reason to think that the dredger was not operating on undisturbed deposit. We think that the " Sir George Lloyd," both as regards dredging capacity and pumping power, underwent the usual tests to which a suction cutter dredger is subjected when a trial on the Clyde is the stipulated bargain. But inasmuch as the pumping capacity of the dredger was not tested through a pipe of the length of 5,000 feet, we are of opinion that the tests to which she was actually subjected were not sufficient to prove that the dredger was in conformity with the contract. On the other hand, the evidence given at Bombay by every witness who had ever dredged with her shows that Mr. Speirs, the dredger master, Mr. Brims and the other Assistants had complete confidence in her capacity and spoke of her as the finest dredger they had ever handled. They said that she could cut down to the last eighteen inches of clay without difficulty and that is in accordance with the evidence of Mr. McMurray, who agreed that she could cut through clay however stiff or hard but at a reduced rate. Indeed he said that on some clay she might only give an output of 500 cubic yards per hour.

108. Having regard to the fact that Messrs. Simons & Co. some years before had taken out the " Kalu " and " Jinga " to Bombay and given a test on site for some 80 hours and obtained an output in excess of the guaranteed 2,000 cubic yards an hour, it is probable that they could have done the same with the " Sir George Lloyd " had they been fortunate enough to strike a region in the harbour where the bed of the sea was composed of mud and soft clay.

The reason why Mr. McMurray would not listen to a test of the " Sir George Lloyd " at Bombay was because he knew Bombay Harbour well and was apprehensive that he might get into stiff material and so fall below the guaranteed output.

### Test of Booster " Colaba."

109. The booster (" Colaba ") was ready for her trials on the 20th February, 1922. She showed a certain amount of vibration, but not enough to cause Sir John Biles to suspect any

structural weakness. Both these vessels having been certified as in accordance with the contract proceeded under their own steam to Bombay. The " Sir George Lloyd " arrived on 30th March, 1922, the " Colaba " a little later. There being no lagoon ready for them to fill, both remained idle for 21 months, with a consequent loss of interest of at least £70,000.

COMMENCEMENT OF DREDGING.

110. The " Sir George Lloyd " and the " Colaba " began work on 8th December, 1923, pumping into Block 8.

It was the practice to take soundings so as to ascertain as nearly as might be the material removed day by day from the sea bed. These soundings were sent to the offices of the Development Directorate, but no calculations appear to have been made from them. The dredger indeed went on working week by week without anyone knowing what output was being given. Calculations from soundings are a recognised method of ascertaining approximately the amount of daily work, and we cannot understand why Mr. Lewis and Sir Lawless Hepper did not have the figures worked out, nor why Sir George Buchanan did not inquire whether soundings were being taken and the results shown by them. Indeed, it was not until July, 1924, that the result of the dredging was known by measurement of material deposited on the site under reclamation.

111. The following facts then came to light :—

Between 8th December, 1923, and 30th May, 1924, the " Sir George Lloyd " had pumped for 843 hours, an equivalent of 56 working days.

Her hourly output of dredged material, as ascertained from soundings, was 1,020 instead of 2,000 cubic yards, her guaranteed capacity.

The amount found to be deposited in Block 8 was only three-fifths of the dredged material, the rest presumably having escaped through the porous rubble mound. Thus, whilst 859,858 cubic yards were shown to have been removed from the bed of the sea, only 528,000 cubic yards were found in the reclamation.

Sir George Buchanan explained that the work so far accomplished was not a fair test, that the first season's working was experimental, and this explanation seems to have been accepted. At this time the position of Sir Lawless Hepper and all concerned in the reclamation was a difficult one. They had commenced the undertaking and had perforce at this time to hope that the next season's working of the dredger would give better results. We are satisfied that Mr. Spiers, a most experienced dredging master, did his best, not only in the first season, but throughout all the time ; and Mr. McMurray made no secret of his opinion that when the dredger got into stiff clay, the output would diminish. As regards the suggested experimental character of the first year's working, there was nothing so unusual in the enterprise as to entitle it to be so described. The first season's dredging must necessarily have

been a failure as regards output for the simple reason that only a single-shift crew had been provided. Sir George Buchanan's estimate was, as we have said, based upon a double shift.

112. The dredger recommenced work after the monsoon in 1924 with the rubble mound and crossbunds in the same porous condition. The vessel gave, as will be seen, an even worse output than in the first year. This may be because it happened to work upon clay of stiffer consistency than in the previous year.

Instead of pumping for 2,550 hours she pumped for 1,473. Instead of pumping 2,000 cubic yards per hour she pumped 856 only, and of this amount only 462 cubic yards were retained in the reclamation. There were according to measurement in the site 680,438 cubic yards of filling as against 1,261,986 as measured by daily soundings.

At this rate the reclamation would have taken, not five years, but more than thirty-five.

113. In the season 1925-6 there was a distinct improvement, owing to the greater number of pumping hours, and the sealing of the wall and crossbund. The dredger worked 1,905 hours, pumped 959 cubic yards per hour, and was found to have deposited in the reclamation 2,264,000 cubic yards, which was a larger amount than she was credited with dredging as recorded by the soundings.

The net result of these figures is that in three working seasons the average hourly output was 941 cubic yards per hour as against the 2,000 cubic yards per hour on which Sir George Buchanan based his estimate.

114. At this point the reader may well be puzzled as to how it happened that a dredger which has been uniformly commended by those in control of it apparently failed so lamentably.

The answer in our opinion is a simple one. The dredger did not fail *qua* dredger, but it was designed to work in soft clay, whereas in truth and in fact she had to work in some proportion of material which was not soft clay—and further she was of inadequate capacity. Consequently gave a reduced output.

This is a most important part of the case and must be elaborated in some detail, and we now propose to set out the varying descriptions of the material as given by Mr. Kidd, Sir George Buchanan, Mr. McMurray and Sir Alexander Gibb.

115. The point for determination is, whether Sir George Buchanan is right in asserting that the material in the Harbour is ' soft clay ' and that stiff clay in this scheme means soft clay.

### Clay : How Described.

116. The following are the descriptions given of the clay which the dredger was to remove and deliver at the rate of 2,000 cubic yards per hour :—

1. 1912.—Mr. Kidd's report . . . " Stiff and unctuous."

2. 1919.—Sir George Buchanan's report agreed with Mr. Kidd, saying, " I accept his conclusion, both in respect to quality and quantity of material." At page 9 of the report he says, " the soft mud will form the bottom layer of filling and the *hard clay which lies below the mud* over the area to be dredged will be superimposed on the mud."

3. 25th July 1919.—Sir George Buchanan's letter to Messrs. Simons . . . " clay " *simpliciter.*

4. 12th September, 1919.—Simons' letter to Messrs. Meik and Buchanan—dredger to be designed for " soft clay."

5. 22nd January, 1920.—Letter, Meik and Buchanan to Messrs. Lobnitz . . . Material " soft clay."

10th January, 1924.—Letter, Sir George Buchanan—it was an agreeable surprise to see *that what was being pumped* consisted largely of a hard compact clay.

14th February, 1924.—Report, Sir George Buchanan, " *the material in the harbour has proved much harder than we were led to suppose,* and actual reclaimed land can be seen and walked upon by anyone who chooses to go to Colaba."

In his Report of the 15th December, 1924, Sir George Buchanan, when speaking of the dredging difficulties of the " Kalu " in Back Bay he says, " The material met with has proved to be very stiff."

117. Further, when speaking of the material in the harbour, he says, " Last season the material actually dealt with was not soft clay but silt and stiff clay with some sand and stones."

He does not in the Report say that it was improper to dredge this material, but continues, " which although much better than soft clay from the point of view of suitable material for reclamation, is heavier and more difficult to pass through the pipe line."

118. Our reading of these phrases is that Sir George Buchanan himself always recognised material as " soft clay " and another class of material as " stiff clay," and these extracts go far to destroy the case he set up before us that stiff clay is soft clay.

119. It will be noticed that the description " soft clay " appears for the first time in Messrs. Simons' letter of the 12th September, 1919. No one reading Mr. McMurray's evidence can have any doubt that that description was chosen deliberately and with the definite object of protecting Messrs. Simons against any claim if it should happen that the dredger failed to give its guaranteed output. A very important circumstance in this connection is that Mr. McMurray knew thoroughly well the nature of the material in Bombay Harbour and it was partly for that reason that his firm would not agree to the suggestion put forward by Sir George Buchanan that the " Sir George Lloyd " should be tested at Bombay.

The fact is that the firm were certain that they could design a dredger which would give according to the usual tests on the Clyde an output at the rate of 2,000 cubic yards per hour.

Even as early as 25th July, 1919, in the first letter which Sir George Buchanan wrote to the firm he stated that he would be content with a test on the Clyde. The material available for dredging on the Clyde is not clay but is a " black clayey silt " and to treat it even as equivalent to soft clay is an assumption in favour of the dredger builders.

120. Sir George Buchanan says he accepted the description " soft clay " because it was the true description.

It may have been true of some portion of the clay in Bombay Harbour, but it certainly is not true of the clay all over the area to be dredged.

Having accepted Mr. Kidd's description of the clay as *stiff* and Messrs. Simons' specification for a *soft clay* dredger, Sir George Buchanan had to say that stiff clay was soft clay and he gave us many illustrations of the word stiff being used in a sense conveying no idea of hardness. He quoted from Mrs. Beeton's Cookery Book where directions are given to mix flour into a " stiff " paste.

It will be seen from the extracts of the evidence given below that experts such as Mr. Kidd, Sir John Biles and Mr. McMurray were not in agreement with Sir George Buchanan that stiff clay and soft clay were the same and that a soft clay dredger would give the same output in stiff clay. That is the important point.

121. In our opinion when Sir George Buchanan accepted Mr. Kidd's description of stiff clay he must have known that it referred to a material denser and more resistent than soft clay. We think he also used the word " hard " in its ordinary signification, and we invite the reader to refer to the very phrases used by him. As regards the use of the word " hard " Sir George Buchanan could not say that hard meant soft, and so he met the point by explaining that he did not mean that the clay *in situ* at the bottom of the harbour was *hard*, but only that it eventually became hard after it reached the reclamation. This explanation does not seem to us to cover the descriptions given above, especially those which we have put in italics.

We do not accept Sir George Buchanan's explanation that stiff and soft clay are the same. At all events, not that type of blue clay which exists in the harbour, and we are quite unable satisfactorily to explain how he was content to allow Messrs. Simons to limit their liability by the word of restriction " soft."

The probability is that he believed the clay in the harbour to be of precisely the same character as that at Sewri and there is some ground for thinking that this may be so; but it should be remembered that at Sewri the dredging was carried down to a depth of 40 feet only. He however most certainly failed to appreciate what was easily ascertainable from Mr. Messent's publication " Some results of the working of the

'Jinga' and 'Kalu'" that these vessels (built by Messrs. Simons also) had throughout the five years of their working averaged only 1,126 cubic yards per pumping hour instead of 2,000. That the reclamation at Sewri was carried out at a price just above the estimate is not of any real importance, as the original estimate, if all the circumstances were known, might prove to have been very much on the safe side.

122. Even when giving evidence he was still under the belief that the 56 per cent. performances of the "Kalu" and "Jinga' were commendable, and he referred with enthusiasm to an output of 1,480 cubic yards per hour supposed to have been done by one of these vessels on some occasion in clay. Mr. Messent's figure is lower, being 1,426, but for the purposes of the argument we proceed on the figure of 1,480. Accepting Sir George's own figure the very best performance at any time was therefore less than three-quarters of the guaranteed output on the Sewri Reclamation. The average figure was 1,126 per hour instead of 2,000 per hour. Yet we find the following passages in Sir George Buchanan's evidence :—

"Now it is worthy of note that the dredger which did so extraordinarly well in the stiff unctuous clay was designed to work in soft clay. The 'Sir George Lloyd' was also designed to work in soft clay and has, I understand, the same cutter as that in use on the 'Jinga.' It seems to follow that if the 'Jinga' did such excellent work in this stiff and unctuous blue clay there is no reason why the 'Sir George Lloyd' should not follow suit."

SIR GEORGE BUCHANAN'S EVIDENCE.

*Sir Grimwood Mears:* I am right in thinking, am I not, that in your Report you approved of the description of the clay as given by Mr. Kidd?—*Answer:* I did. Yes.

"*Question*: In terms?—*Answer*: In terms.

"*Question*: As stiff?—*Answer*: As stiff clay, that is, stiff unctuous clay in which the 'Jinga' did such extraordinarily good work."

123. In giving these answers Sir George Buchanan must entirely have overlooked that if the "Sir George Lloyd" followed suit" in this "extraordinarily good work" his time table based upon 2,000 cubic yards per hour would go entirely astray, and the Government of Bombay, which had paid over £700,000 for the dredging plant, would get only three quarters of the guaranteed output.

When Sir George Buchanan was making up his mind to recommend the acceptance of Messrs. Simons' tender and also deciding that the reclamation should be done by dredging it was of the utmost importance for him to find out to what extent these vessels had worked up to their guarantee. Nothing was easier.

The figures were available to him in Mr. Messent's pamphlet which was actually in his possession, but he neglected to study them.

That this is perfectly certain appears from the evidence given by him on the first day, at which date he had not found Mr. Messent's pamphlet and had forgotten that he ever had it.

*Sir Grimwood Mears:* Did Mr. Messent ever give you any figures of the performances of the " Kalu " and " Jinga "?—*Answer:* No, I do not think he did. I do not remember any detached figures.

MR. MCMURRAY'S TESTIMONY.

124. *Sir Grimwood Mears:* A firm of dredger builders might, I suppose, build an excellent dredger designed for soft clay which would not give or might not give satisfactory results in stiff hard clay?—*Answer:* That is right. It might not be able to dredge it all.

*Question:* It is a question of degree?—*Answer:* Absolutely.

*Question:* If a dredger designed to work in soft clay was put to work on stiff or hard clay, while she might be able to cut it, you would not expect the same output as if she were working in soft clay?—*Answer:* Certainly not.

*Question:* Therefore, I suppose the contention of your firm is that you, having contracted to design a dredger for working in soft clay, that is the limit of your responsibility?—*Answer:* Absolutely, so far as that is concerned. We give that output in soft clay, not harder material.

*Question:* We know that there has been a very great failure of output in the dredging operations—I am not using the phrase, failure of the dredger?—*Answer:* I observe that, thank you.

*Question:* It is a failure of output in the dredging operations. As an expert will you give me your view of the various causes. Let us have them 1, 2, and 3?—*Answer:* I think the first and most important is this question of the material. That is the first and most important thing of the whole lot.

*Question:* A dredger designed for soft clay is put to work in stiff clay—is that the point?—*Answer:* Taking everything right down to the rock, as far as I understand it, or moorum.

* * * * *

The dredger has been designed for this output in soft clay. She will take anything that is in the harbour, practically speaking, down to the rock, at a very much less rate according as it differs in consistency and hardness.

*Question:* That is right?—*Answer:* That is the whole thing.

*Question:* That in itself would be one cause for a greatly diminished output?—*Answer:* Absolutely.

*Sir M. Visvesvaraya:* You were going to explain to the Chairman why you put in the words " soft clay " in the tender, or in the agreement. Will you kindly explain that now?—*Answer:*

Yes. " Clay " seemed to us to be a very indefinite term; it might be soft or stiff or hard or anything. We must reasonably expect to have some more concrete definition of the consistency of the material. We put it as soft clay, and we said at the time that this dredger, as designed, would cut, practically speaking, all the kinds of clay there are in the harbour there. It would not dig rock, but it would dig the different kinds at different capacities.

*Question:* When you manufactured the plant, did you feel quite sure that it would do its work?—*Answer:* We felt quite sure that it would do its work in soft clay, and also that it would dredge practically all the stuff in Bombay Harbour, except the rock, but at a very much lower rate according as the stuff got stiffer.

*Sir Frederick Hopkinson: Question.*—You know all about the clay in Bombay better than anybody else?—*Answer:* Yes, and I know we can get hard clay.

*Question:* The fact of testing a dredger in Bombay was not an unknown thing to you? You had already had an order for building dredgers to be tested in Bombay?—*Answer:* Yes.

*Question:* Do you know why you refused to do it in the case of the " Sir George Lloyd "?—*Answer:* Well, I have already given the reasons twice, I think. One of the reasons was because from the experience that we had had already in Bombay we saw that there were some very uncertain elements in connection with this thing on account of the material. We might be put into a position where we could not get sufficient soft clay. We might have to dredge a lot of hard stuff.

In reply to Mr. Billimoria, who wanted to know if the construction of the dredger would have been different for stiff and hard clay, the witness said: " A totally different one at a totally different price."

### Sir John Biles' View.

125. In reply to questions by the Chairman, Sir John Biles said that, in his opinion, a dredger builder whose vessel had to work in soft, stiff and hard clay would fit it with an average cutter, " probably sacrificing on the harder conditions in order to make good on the softer conditions.

*Question:* On the harder there would be a certain amount of slowing up of the cutter?—*Answer:* Yes, or it might be stopped."

*Sir M. Visvesvaraya:* When you designed the dredger did you get all the particulars which were needed about the material in which it had to work?—*Answer:* None whatever.

*Question:* Why was that?—*Answer:* The dredger I was told to design was described in the letter of Messrs. Simons, and I went ahead and did it. (The reference is to the letter of Messrs. Simons & Co., of 12th September, 1919, " soft clay " and " general conditions.")

126. Mr. Kidd in 1912 made 1,314 borings in the harbour and we have his record of 1,159. He was aware of the Sewri Mazagaon Reclamation and was familiar with the " Kalu " and the " Jinga " and " had a very low opinion of the efficiency of their machinery." He says that he never described the clay in the harbour as " soft," nor as " hard," but as " stiff."

He has every claim to be regarded as an expert with special knowledge of the actual material in Bombay Harbour. This is what he says :—

MR. KIDD'S EVIDENCE.

*Sir Frederick Hopkinson:* As far as your information, your survey and your borings go, can you say that the material in the harbour is soft clay and not hard clay?—*Answer:* I have never described it as soft clay. I do not agree that it is hard clay, but I have never described it as soft clay.

*Question:* You described it as stiff clay?—*Answer:* Stiff and unctuous.

*Question:* Would not there be a material difference between soft clay and hard clay?—*Answer:* There might be a considerable difference, yes—a material difference for this purpose.

*Question:* If a dredger was built for stiff clay, the specifications supplied to the dredger builders would be absolutely incorrect?—*Answer:* I do not know what that specification was.

*Mr. Billmoria:* Therefore if they were supplied with a specification to build a dredger for soft clay, that dredger could not be expected to get out hard clay?—*Answer:* Or even stiff clay.

*Question:* In that respect therefore the specifications would be absolutely incorrect?—*Answer:* If the specifications said it was soft clay, they were absolutely incorrect.

*Chairman:* Mr. Billimoria is on page 20 of Sir George Buchanan's report. (*Handing same to witness who perused Simons' description of a soft clay dredger.*)—

*Answer:* All I can say about this paragraph is that if the dredger was designed for dredging 2,000 cubic yards of soft clay per hour. I am not surprised that she has made a very much less performance in stiff clay.

127. Later on in this Report we give an extract from the 1926 Report of Sir Alexander Gibb. We need only say here that Sir Alexander Gibb had no doubt of the existence of some soft clay in the Harbour, and as we read the extract a greater proportion of hard clay. Also the statement of Sir George Buchanan's partner, given below, where he describes the clay as it issued from the discharge pipe proves its consistency to be very different from that of soft clay.

128. With this evidence before us let us now consider how the matter stood in November, 1919, before any cost on plant had been incurred.

The problem was to build a dredger adapted to the exact nature of the material to be dredged. The nature of the material, whether soft, stiff or hard, was unalterable. Therefore the dredger had to conform to the material.

In our opinion the initial mistake which Sir George Buchanan made was in thinking that dredging conditions in the Harbour would be in all respects similiar to those at Sewri. Assuming that the material was the same, he overlooked the fact, as we have previously said, that the " Sir George Lloyd " had a dredging depth of 70 feet as opposed to 40 feet of the " Kalu " and " Jinga."

At the outset Sir George Buchanan told Messrs. Simons that a dredger of the " Kalu " or "Jinga " type was the kind of machine which was wanted. We have no quarrel with the type of vessel but the disastrous results which followed were due to his failure to specify a machine of the requisite capacity to give the output on which his whole scheme was based.

The " Kalu " and " Jinga " were of 2,700 horse-power. The " Lloyd " was 3,000. What was wanted was a dredger of very much greater capacity and in our opinion—and to this we attach the greatest importance—the makers should (apart from any description of material) have been required to build a machine guaranteed to deliver not " at the rate of 2,000 cubic yards per hour " but " at the rate of 3,500 or 4,000 cubic yards per hour " on test. In that way and in that way only would an average hourly rate of 2,000 be attainable under ordinary working conditions. The experience of the working of the " Kalu " and " Jinga " bear this out. Each was guaranteed to do 2,000 cubic yards per hour which they did on test. Their average, as we have repeatedly said, was 1,126, spread over 5 years working. Mr. Kidd said that to get 2,000 cubic yards per hour " it would certainly have been the most powerful dredger that had ever been built in the world." If no dredger builder would design so powerful a vessel, and Mr. McMurray's evidence indicates that this might be so, then two dredgers and two boosters should have been ordered; or if the cost of such plant was prohibitive, as well it might be, the scheme as a dredging proposition should have been abandoned.

129. According to Mr. McMurray he told Sir George Buchanan that all his firm could do would be to provide a dredger which would deliver 2,000 cubic yards per hours of soft clay " and if that was not sufficient they would have to get two dredgers."

MR. MCMURRAY'S EVIDENCE CONTINUED.

*Sir Grimwood Mears:* " Would you have constructed a dredger of a different character if you had guaranteed it to work 2,000 cubic yards per hour in stiff clay?—*Answer:* No, we would not have constructed one of a different character. It would have been much the same but there would have been two of them."

130. We have already given extracts from Mr. McMurray's evidence as to the certainty of reduced output of the " Lloyd " in material other than soft clay, and we are driven to the conclusion that the dredger was not of sufficient power to cut and deliver the material as it existed in the harbour at the rate of 2,000 cubic yards per hour, and that no sufficient steps were taken to ascertain the nature of the material and to ensure that the dredger as built was adapted to the particular material.

131. Notwithstanding the extent of Mr. Kidd's experience of borings in the harbour, he stated emphatically that " the exact character of the material should have received particular examination by means, not merely of the borings, but by an actual dredging trial . . . . . A bucket dredger would have done perfectly well, which would have shown the designer himself exactly what material he was going to deal with."

132. It was put to Sir George Buchanan that he ought to have taken a few check borings after his arrival in Bombay in November, 1919, and that had he done so he would have been able to see for himself the character of the silt or mud and of the blue clay. He agreed that this could have been done, but said it was quite unnecessary as he knew all about the material. The following extracts from his own Reports prove that he did not, and his failure either to require Messrs. Simons to send out a man to see the material for himself or himself to ascertain its exact nature was a grievous omission.

*Report, February*, 1922.—" Much depends on the nature of the material dredged and that can only be definitely ascertained when actual dredging begins."

*Report, February*, 1922.—" . . . the only uncertainty concerns the exact nature of the material to be dredged from the harbour and used as filling."

*Report, 10th January*, 1923.—" Until the nature of the dredged material is seen it is impossible to say how many walls (i.e., cross-bunds) will be required."

*14th February*, 1924.—" The material in the harbour has proved much harder than we were led to suppose."

*15th December*, 1924.—" In our letters dated 22nd June and 2nd July, 1921 . . . . we said we were unable to accept, without much more information, the pessimistic reports as to the unsuitability of the material in the harbour and that it was impossible to come to any conclusion until a dredger had been actually at work for some time on the spot."

*On 8th December*, 1922.—" I convened a conference on the subject of dredging . . . the first thing to do was to ascertain the precise nature of the material in the harbour by a practical test with a grab or other dredger and this was agreed."

We call attention to the date, 8th December, 1922. In our opinion it was the " *first thing to do*," not in December, 1922, but at the outset of his enquiries in May, 1919.

*Report, 15th December*, 1924.—" I observed in a letter of the 10th January, 1924, that after the grave doubts which had been expressed at various times as to the suitability of the material in the bed of the harbour for reclamation purposes, it was an agreeable surprise to see that what was being pumped consisted largely of a hard compact clay with which we had reason to be quite satisfied."

Sir George Buchanan says that the real point of all these statements is that he was in doubt as to whether the material was of a character that would dry out and make good reclaimed land. That was a matter which he admitted could have been readily ascertained by experiment in November and December, 1919, and was a matter of the greatest importance. It would be useless to pump material into the Reclamation which, by reason of its retention of or affinity for water, would not dry out and the characteristics of the material ought to have been ascertained with the same care as the actual existence of material before any order for a dredger was given.

Other extracts to the like effect are to be found in his Reports and correspondence, but we have given sufficient for the reader to form his own opinion as to whether Sir George Buchanan had in February, 1921, sufficient knowledge of the character of the material to be able to pronounce on a dredger of proper design and further whether he had any knowledge that the material when deposited in the reclamation area would dry out.

In our opinion the answer to both these questions is in the negative.

### Proposal to Dredge in Back Bay.

133. It was partly in consequence of the adverse reports of Mr. Mitchell, a geologist, as to the character of the material that it was decided to dredge in Back Bay.

Such was the ignorance of everyone on a matter which could have been ascertained with certainty by December, 1919, that three years later, in December, 1922, a proposal was put forward and carefully considered. If adopted, it would have meant a complete reversal of the original scheme. The memorandum of the meeting of 14th December, 1922, at which Sir George Buchanan was present, says :—

> " It was agreed that if sufficient first class material could be obtained from Back Bay without undue risk to pipe lines and dredgers, it would be better to use it rather than the mud and clay from the harbour. There was, however, no indication at present that large quantities can be obtained from Back Bay, and therefore plans must be proceeded with to use harbour material."

134. In fact, dredging is now proceeding in Back Bay, and there is a fair prospect of getting reasonably good results this

season. The extract is set out to give additional weight to the fact that the scheme was started without anyone knowing the nature, quality, depth and characteristics of the material in the harbour.

### Failure of Dredging Operations.

135. Although the dredging operations have fallen so greatly below the estimate, care must be taken to distinguish between the dredging operations and the dredger itself. As we have said, everyone has spoken in praise of the " Sir George Lloyd " as a dredger, and there has been no complaint whatever as to her machinery, whether propelling, pumping or cutting or her stability, but by reason of her inadequacy of designed capacity to which we have referred above it was impossible to expect a much greater output than has been given. Sir G. Buchanan in his Report dated 15th December, 1924, said it was improbable with the class of material then being taken from the harbour that the vessel would do her estimated output of 5,000,000 cubic yards per annum. " If we get two-thirds of the estimated total output we shall be doing well, but naturally the time required to complete the work, and the cost of pumping will be increased."

### The Human Element.

136. Sir George Buchanan has attributed the failure of the dredging operations to a considerable extent to " the human element."

He admitted that Mr. Speirs was a good dredging master. His own firm put forward Mr. Brims as a dredging expert. His view apparently is that the crew could have got the guaranteed output from the " Sir George Lloyd " only they would not do so, because they were not being paid on a bonus basis. That is, that the crew were guilty of deliberately short output. As Sir George Buchanan had said in his letter to the Press, after the publication of the Report of the Advisory Committee, that the dredger had been " mishandled," we asked every witness in Bombay who had been at work on the dredgers whether Sir George Buchanan ever made any complaint of any kind. On the contrary they said he gave them praise, and Sir George Buchanan himself, when examined before us, agreed that he made no complaint.

We are of opinion that he was adopting in his evidence the line taken by Mr. Brims in Bombay who had first introduced the phrase " the human element " as one of the possible causes of reduced output.

### The Dredging " Too Deep " Theory.

137. Sir George Buchanan also laid stress on another point. He said that the low output of the dredger was due to the determination of the dredging master to get the last available yard

of the material, and that that brought the cutter into contact with the moorum, stones and rock lying below the bed of clay.

The evidence of this having happened in fact is of the slightest description. Mr. Brims told Mr. Halcrow in the summer of 1923 that there had been a "tendency" to cut too deep, and Sir George Buchanan has fastened on this statement and greatly elaborated it. Mr. Halcrow also brings forward in corroboration the circumstances that on one occasion the blade of the cutter was damaged by rock. His confrère Mr. Settle who spent some weeks in Bombay in 1925 dismisses this circumstance as of no account, and as one to which no importance can be attached and as a matter "of very frequent occurrence at other places." We reject this theory because we do not believe that Mr. Speirs, who has had lifelong experience in dredging, would commit so elementary and foolish a mistake nor allow others to do it. Undoubtedly at times the dredger came suddenly upon moorum and possibly even rock, but that was because it was not possible for the crew to know with accuracy exactly what depth of mud and clay was beneath them. But we have no reason whatever to believe that they did not lift the cutter and move away when they found themselves touching moorum or rock.

### Mr. Halcrow's Report.

138. Mr. Halcrow in fact gave three reasons for the admittedly unsatisfactory position of the dredging. He is Sir George Buchanan's partner. The first reason given by him in his report of the 30th December, 1925, is:

"The unsuitability of the material."

Whether it was as suggested by Sir George Buchanan of the consistency of butter, cheese, or stiff paste—whether it was soft or stiff or hard may be judged from the following passage:—

"On Saturday morning 21st idem (i.e., November, 1925) I went to the pipe-line at Colaba, where I stayed some little time watching the discharge of material. . . . The clay had been delivered in more or less round balls from 18 inches diameter and downwards.

It was of *a stiff consistency, as walking over it and even jumping on it from the top of the pipes made only a very slight impression on it.*"

We underline this passage.

139. The second reason, according to Mr. Halcrow, was "the difficulty of obtaining the material owing to the uneven level of hard material, moorum, which the dredger cannot deal with, and consequent loss of much time in lifting and lowering the cutter."

Here it will be noticed that Mr. Halcrow does not for a moment suggest that the crew had any determination to dredge down into the hard material, but that they came upon it unexpectedly and unavoidably, and lost time in lifting the cutter out of it, and in lowering it again to recommence operations.

140. The third reason is " the unsuitability of the men, assistant dredging masters, etc., sent out from London.

It was the practice for a member of Sir George Buchanan's firm to be present at the High Commissioner's Office when candidates were interviewed, and we assume that the best men were chosen on their recommendation. If good assistant dredger masters are unprocurable or most difficult to procure, that was one of the points adverse to reclamation by dredging which should have been set out in the Report.

141. We are of opinion that the reduced output is accounted for to a large extent by the fact that a certain proportion of the clay cannot fairly be described as soft, and that the capacity of the " Sir George Lloyd " is insufficient to deal with the material as it exists in the harbour at the guaranteed rate of 2,000 cubic yards per hour. It most certainly can cut through any clay, but with a gradually reduced output, as the material varies from soft to hard.

142. When Mr. Kidd was in the witness-box he had with him his original calculations prepared for his 1912 Report. In giving details he mentioned that he had specified for a dredger of a horse-power of 7,500. When told that the " Sir George Lloyd " was 3,000 horse-power he made a most expressive gesture of surprise, and said, " Your difficulties are explained." Sir George Buchanan was of opinion that the figure of 7,500 horse-power was the addition of all the horse-power in the vessel for whatever purpose used, and he expressed the wish that we should communicate with Mr. Kidd and inquire what would have been the pumping power of the dredger in the vessel contemplated by him. Accordingly we did so, and by letter dated 25th November, 1926, Mr. Kidd stated that the dredging pumping power would have been 4,800 horse-power to 5,000 horse-power, which compared with the " Sir George Lloyd "—3,000 horse-power—is more than 50 per cent. in excess.

### Dredging in Back Bay :—Purchase of " Kalu " and " Jinga."

143. From the letter of 10th July, 1920, sent by Sir George Buchanan to the India Office it is evident that when he was asked to consider the building of the sea wall from both ends he considered that the dredger " Kalu " might with advantage be used for the reclamation of Back Bay. Apparently it was originally intended to use her for a second smaller reclamation on the East Colaba side. That fell through, and need not be discussed. At all events, it is certain that Sir George recommended her purchase in September, 1920, and she was bought in November of that year.

She was a most expensive acquisition. Sir George Buchanan has stated, and we agree with him, that his recommendation was, of course, subject to inspection and approval. We have no

information as to whether she was even inspected, or when or by whom or what was the nature of the report, but it was discovered that she required extensive repairs.

She was 11 years old, having been supplied by Messrs. Simons and Company to the Port Trust in 1908. Her price at that date was £56,500, and with certain extras came to just over £60,000.

The Bombay Government paid £75,000 for her, spent about £27,000 on repairs, and a further large sum to provide a pipe-line. It was five years from the date of her purchase before she did any work, and in interest alone this represented a loss of more than £20,000. In the circumstances under which she was put to work in Back Bay itself in November, 1925, her performances were farcical. Sir George Buchanan described it as one of the most disgraceful things he had ever heard of in his life.

Yet Sir George Buchanan was in Bombay on the first day that the " Kalu " set out on the enterprise, and remained in Bombay for many weeks thereafter. He was the technical expert, adviser, and supervisor to the Government of Bombay. On no one occasion did he ever go aboard the " Kalu " to see what was really happening—he accepted the assurances of the dredging master or assistant dredging master that she would do better next day, and that all difficulties would be at an end, and he entirely failed to perceive that it was his manifest duty to ascertain what was being done, and to speak out decisively about it. The net result of the " Kalu's " work for the whole season of 1925-1926 came to less than eight hours of her guaranteed output. That is to say, she did 15,600 cubic yards of dredging in one season at a working cost of about £10,000. The reclamation effected by her cost for every cubic yard 31 times as much as Sir George Buchanan originally estimated it, amounting to no less than Rs. 15½ per cubic yard.

When it was proposed to send the " Kalu " to Back Bay Sir George Buchanan, drawing a wrong inference from the conditions of the Sewri Reclamation, thought that the " Kalu " could dredge her own flotation in about three tides. Apparently she had previously done that at Sewri, which was principally mud and with an absence of rock The bed of Back Bay was of hard material on which it would be unsafe for the dredger to ground; and so it happened to the knowledge of Sir George Buchanan that the " Kalu " had to move to her dredging position when the tide was sufficiently high to carry her in, and to hurry out again when the tide was beginning to drop. She, in fact, was working for a few hours every other week at spring tides. Although Sir Lawless Hepper has disclaimed the possession of any technical knowledge, he, as well as Sir George Buchanan, should have ascertained what was taking place, and should have stopped this waste of public money.

144. Having acquired the " Kalu " the next step was the purchase of the " Jinga " who was to work in conjunction with the

" Kalu " as a booster. She was a sister ship to the " Kalu " made by Messrs. Simons and Company and bought at the same time. There was therefore at an early stage an intended duplication of the original scheme. The " Jinga " bought, in known bad condition, for £10,000 has perhaps providentially never had an opportunity of showing her qualities. She went into dry dock and had been there more than 12 months, when we inspected her in August, 1926 When she will ever emerge to take part in the scheme, or if she will ever do so, is doubtful. She can hardly be made effective for less than an expenditure of £40,000, and this with the loss of interest will equal, if not exceed her cost when new in 1908.

145. Reviewing the whole unhappy business of the purchase of the dredgers and their work we find the salient facts to be as follows :—

(i) When Sir George Buchanan left Bombay for England in order to arrange for the purchase of a suitable dredger he accepted Mr. Kidd's report as sufficient warranty for the conclusion that an adequate supply of material suitable for the purpose could be obtained by dredging in Bombay harbour. Yet three years later we find him noting that " the first thing to do was to ascertain the precise nature of the material in the harbour by a practical test with a grab or other dredger." In our opinion this was the " first thing " which should have been done, not in December, 1922, but in May, 1919. Had this experiment been made then, Sir George Buchanan could have ascertained by personal inspection what Mr. Kidd meant by the " stiff and unctuous " character of the material to be dealt with; he would not have been troubled during the year 1921 by " pessimistic reports as to the unsuitability of the material in the harbour "; or have found it an " agreeable surprise " in January, 1924, that " what was being pumped consisted largely of a hard compact clay."

(ii) The actual purchase of the dredger " Sir George Lloyd " was pushed through as a matter of urgency; yet this vessel and her attendant " booster " reached Bombay in March-April, 1922, only to remain idle for some twenty-one months.

(iii) The entire project was one in which heavy initial outlay was to be recouped by handsome profits after its completion; the time to be occupied in carrying the work through was therefore an element of the utmost importance for the consideration of those responsible for deciding whether it should or should not be taken in hand. The Government of Bombay accepted Sir George Buchanan's estimate that the dredging part of the scheme could be completed in five years, and this estimate was based upon the procuring of a dredger capable of giving a steady hourly output of 2,000 cubic yards of the material actually to be

found in the harbour at Bombay. Yet Sir George Buchanan accepted, and recommended for purchase, a dredger whose manufacturers carefully safeguarded themselves by stipulating that it would be capable of this output only when the material to be dealt with was "soft clay", and on test only. Their London Representative, Mr. McMurray, made it perfectly clear in his evidence that his firm deliberately tendered for a dredger capable of this output only when dealing with material which could fairly be so described. Mr. McMurray knew a great deal about the conditions of dredging in Bombay harbour: his evidence shows that if Sir George Buchanan had stood out for a contract to supply a dredger capable of the desired output in respect of the material to be found in that harbour, his firm, if they tendered for the contract at all, would either have proposed a "totally different" dredger "at a totally different price," or have suggested the acquisition of two dredgers each of the capacity of the "Sir George Lloyd."

(iv) The failure of the "Sir George Lloyd" to give anything like the output upon which Sir George Buchanan's whole calculation was based was not, to any appreciable extent, due to any shortcomings on the part of those who worked it: it was from the first inevitable in view of the designed capacity of the dredger and in view of the material upon which the dredger was called on to work, and could obviously have been predicted by Mr. McMurray. It is idle to talk about the "human element" as a decisive factor, or even as one which had any material bearing on the result. In so far as the "human element" entered seriously into the matter, it was in the appointment of an unsuitable man as Resident Engineer in charge and the saddling of the man, when appointed, with office work which prevented him from exercising close, constant and energetic supervision over the actual operations.

(v) The porous character of the rubble mound as originally constructed without moorum backing was a mistake; and this would have been set right sooner than it was if a lingering doubt as to suitability of the material actually being dredged had not led to a curious indifference as to the loss of a large proportion of it.

(vi) The division of responsibility between Sir George Buchanan and his Firm on the one hand, and the Development Directorate and Sir Lawless Hepper on the other, led to slowness in appreciating and delay in acting upon facts which should have been glaringly apparent after the first year's working. It partially explains, but does not justify, the issue of optimistic reports at a time when the entire scheme was showing every sign of disastrous failure in one of its essentials, namely, the proposed completion of the work within a period of five years.

## Uneasiness in Bombay. Appointment of Committees.

146. Early in 1924 there was a certain feeling of uneasiness as to the progress of the works and the future prospects of the many schemes of the Development Directorate. Mr. Lalji Naranji had put forward a resolution asking for an inquiry into the activities of the Development Department and for an opinion as to how far and in what directions such activities should be continued or eliminated. The Government of Bombay, by letter dated the 25th August, 1924, requested the Advisory Committee to the Development Directorate to undertake this task.

147. On the 4th December, 1925, the Government of Bombay purported to cancel the agreement of the 17th March, 1921. We need not detail the circumstances which induced the Government to take this step as it is no part of our duty to determine whether they were right or wrong in the course they took.

148. On the 21st January, 1926, the Advisory Committee issued an interim Report specially devoted to the Back Bay Scheme, and this document, together with the forcible dissenting Report of Mr. Manu Subedar, profoundly stirred public opinion in Bombay and throughout the Presidency. The Development Directorate and its various schemes were the subject of strong criticism in the ensuing session of the Legislative Council and, as was only natural, the Back Bay Reclamation Scheme and those responsible for its inception and conduct were the objects of special attack.

149. A Sub-Committee of the Advisory Committee had reported on the financial prospects of the scheme and, basing their calculations on the results actually obtained in the past, were of opinion that the scheme would cost 11 crores and not be completed until 1944-45.

150. By April, 1926, there was reason to believe that the dredging results of 1925-26 were considerably better than in previous years, and as a consequence a Committee was appointed on the 19th April, 1926, to revise the estimates of the Advisory Sub-Committee. Their findings were to be considered by yet another Committee, who, having weighed the financial position of the scheme, were to report what, if any, further portion of the work could be undertaken with a reasonable prospect of reducing the loss, and in this connection to have special regard to Blocks 1 and 2. The first Committee was presided over by Mr. Neilson, Chairman of the Bombay Port Trust, the second by Mr. Kay, Chairman of the Bombay Chamber of Commerce. The Reports were signed on the 30th July, 1926, and 20th August, 1926, respectively, and were placed before us.

## No Charges of Dishonesty.

151. On three occasions in Bombay we announced publicly our willingness to receive evidence from anyone who could give us assistance upon any matters coming within our terms of

reference. One of these matters undoubtedly was the conduct of the officials of the Development Directorate in relation to the reclamation scheme.

152. In March, of 1925, Mr. Nariman stated in the Legislative Council that there were ugly rumours in the City that the higher staff of officers in the Development Directorate had been receiving secret commissions from manufacturers.

It may be true that there were ugly rumours, but as far as our inquiries into the affairs of the Back Bay scheme have gone there has not been the very slightest evidence brought forward that these ugly rumours had any foundation in fact. No one has brought any charge against any manufacturer of having given, or any official, high or low, of the Development Directorate of having accepted a commission. When Mr. Nariman gave evidence before the Committee he did not disclose any fact which in the least degree implicated anyone of wrong-doing of this character. There has not been throughout the whole of the inquiry the least suggestion that anyone interested in supplying or ordering goods for the reclamation or assisting in the work of the reclamation has been guilty of any dishonesty of any kind whatever.

## Sir Alexander Gibb's Report.

153. In January, 1926, Sir Alexander Gibb, a well-known engineer, happened to be in Bombay, and he was asked by the Government to report on the position of the work. He stated that the results of the dredging were most unsatisfactory, and he said, " the reason for this is the unsuitability of the dredging plant for dealing with the material as it exists both in the harbour and Back Bay." By unsuitability we assume that Sir Alexander Gibb meant the inability of the dredger to dredge 2,000 cubic yards an hour regularly.

He continues, " Although I am informed that the borings have been found substantially correct in so far as hard and soft materials are concerned, the nature of these materials is, in the main, either too hard to obtain an economical output for the dredger or too soft to provide *satisfactory filling* for the purpose of reclamation. Added to this, a very large portion of the material is situated at too great a distance from the site of the Reclamation to be pumped economically with the dredging plant as specified and delivered. . . . I am faced with the conclusions . . .

" (*d*) That there is, however, soft clay available in the harbour within working distance of the Reclamation Block No. 8, which could be pumped with the assistance of the floating shore dredging plant in sufficient quantities to complete this area. That this material, though I could not recommend it generally for the reclamation of land which it is intended to build over, would nevertheless be suitable for Block No. 8, which I understand is

to be utilised for parade purposes and into which a substantial depth of hard clay has already been pumped. The dredging plant will probably sell for a better value if the dredger has proved herself by dredging in Bombay more approximately to the quantity of material for which she was designed."

154. The entire success of Sir George Buchanan's scheme was based upon the dredger working in silt or mud and soft clay, and giving every hour her guaranteed output. Stiff clay in the sense of clay more resistant than soft clay or hard clay never entered into his calculations. That was one of the pivotal mistakes of his whole scheme.

155. Sir Alexander Gibb says that " all reasonable care and skill has been exercised by those in charge of the work to secure the best results out of the dredging plant."

### The Reports of the Development Directorate.

156. The hostility that was shown towards the Development Directorate was increased by the circumstance that there was believed to have been concealment of the true position.

It was the practice of the Development Directorate to publish annually a " Report on the Working of the Development Directorate." That body, as we have seen, had many other activities besides the Back Bay Reclamation, but the latter was by far the most important. Sir Lawless Hepper has taken full responsibility for the Reports which were indeed drafted by him. His attitude in this respect gained our approval. When in August, 1926, he gave his preliminary Statement to the Committee he laid the greatest emphasis on the point that Sir George Buchanan had ordered a soft clay dredger and he put this forward as one of the " mistakes " which had proved " disastrous." It is evident that by 31st March, 1922, Sir Lawless Hepper had not noticed this point because at page 6 of the Report of that date he speaks of the dredger as " capable of dredging 2,000 cubic yards of clay per hour."

In the report for the year ending 31st March, 1924, he says, " the material obtained proved to be of a much better quality than had been anticipated, being a heavy hard clay with sand ". From first to last in the Reports he gives no figures such as are set out above, i.e., figures showing less than fifty per cent. of the guaranteed output, nor does he make mention of the failure to work the necessary number of hours and he is silent as to the loss of material. There is no doubt that these Reports must have conveyed a false impression of the progress of the work and were misleading. The report dated 31st March, 1924, was in fact published about July 1924 and similarly that for the year ending March, 1925, appeared in or about July, 1925. Sir Lawless Hepper knew what had been happening and yet commenced the March, 1924, report. " The Reclamation and housing schemes made satisfactory progress."

In March, 1925, he wrote " Work on the Back Bay Reclamation Scheme and on the Housing Scheme made steady progress during the year." As a partial justification he alleged that he was in a difficulty both as regards Sir George Buchanan and the Government. He was anxious to say nothing which would embarrass either. At the same time a perusal of his Statement of August, 1926, shows that he had no disposition at that time to spare Sir George Buchanan or Messrs. Meik & Buchanan. He was at that date and in his evidence endeavouring to put the whole responsibility for the " disastrous combination of mistakes " on the shoulders of Sir George Buchanan.

The Reports are also silent upon the increase of the estimate from 367.61 lakhs to 702 lakhs, and anyone reading the Reports and having no other sources of information would believe that the scheme had been from its inception one of 702 lakhs.

157. At the same time, some allowance must be made for Sir Lawless Hepper. His position was one of extreme difficulty and great anxiety. He was apprehensive of creating a " panic " which might prematurely wreck an enterprise which he hoped would eventually extricate itself from its initial difficulties. But when everything is said on his behalf the fact still remains that the annual Reports did not, as far as the Back Bay Reclamation Scheme was concerned, present a true picture of the progress of the work.

### The Alleged Policy of Silence.

158. We have spoken of the absence of discussion between the Government of Bombay, the Port Trust and the Royal Indian Marine. That has been, in our opinion quite rightly, a matter of public criticism.

159. The allegation has also been made that there was a definite policy of official secrecy and that contrary to custom the public were not taken into the confidence of the Government of Bombay with regard to the development schemes. Some of the operations of the Development Department necessitated the acquisition of land and as regards this it was most important that the intentions of Government should not be known and prudent to preserve secrecy about them. As regards the Back Bay reclamation the first point to be noted is that more than ten Committees had discussed reclamation in some form or another, and the need for action was fully appreciated by the Government of Bombay. Definite pressure was being put upon them by Mr. Montagu. Development had been delayed for years, but extracts which we have set out from minutes and despatches, and especially the minute of 6th April, 1920, prove most conclusively Mr. Montagu's determination that schemes on a large scale should be undertaken so that the condition of life in Bombay might be ameliorated. Lord Lloyd, in dealing with this question of secrecy, laid stress

on the fact that the scheme was submitted to the representatives of the people of the Presidency, viz., the Legislative Council with all the publicity which that implied and that they accepted the scheme without dissent.

### Should Work of this Character be done Departmentally or by Contract?

160. It will be remembered that when on previous occasions a Reclamation Scheme was proposed the question of the agency by which such work should be done was always a matter of consideration. In the terms of reference Sir George Buchanan was also asked for his opinion " whether the entire work should be given out as one complete contract or divided up into small contracts or the whole work carried out departmentally."

Sir George Buchanan stated that the usual and best method of carrying out a large public work was to adopt one of three courses :—

(1) Tenders to be invited for the execution of the whole work on working drawings, specifications, bills of quantities and conditions of contract supplied by the Engineers entrusted by Government with the project.

(2) The work to be divided into sections and tenders to be invited for each section on the above lines.

(3) The work to be carried out departmentally on working drawings, specifications and estimates prepared by the Engineers entrusted by Government with the work.

If there were any Contractors who possessed adequate dredging plant he would have recommended tenders for the whole work. A new dredger or dredgers and new plant had to be obtained and he recommended one of two courses :—

(1) (*a*) Tenders to be asked for the construction of the sea wall and a contract placed if a satisfactory offer is received.

(*b*) Tenders to be also asked for the moorum filling and construction of roads, drains, etc., and either one contract or several smaller contracts to be arranged.

(*c*) The Government to purchase the dredging plant and carry out departmentally the work of filling the area to be reclaimed.

(2) The whole of the work to be carried out departmentally, making use of local contractors for small contracts.

161. He stated that he was in favour of the first course if a suitable tender was received for the construction of the sea wall.

Eventually as has been already stated Government decided to do the whole of the work departmentally. This decision was influenced no doubt to some extent by the belief that in the then uncertain conditions of trade no contractor would venture to give or could give a close price. He would necessarily have to make large allowances for contingencies. At the same time

we are of opinion that the decision to do the work departmentally was a mistake. Lord Lloyd hoped by the creation of the Development Directorate to secure greater elasticity of working than would be attainable in a department such as the Public Works Department whose actions and decisions were necessarily circumscribed by departmental rules. Lord Lloyd hoped no doubt that the Development Directorate would assume in all respects the functions of a contractor and be able to decide all matters with the same unhampered freedom. In practice it did not so work out. We may take the instance on which Sir George Buchanan has laid so much stress, " the magical effect of a bonus." A contractor anxious to speed up the work could have decided at once to give a bonus and to give it on a handsome scale. We doubt if Sir Lawless Hepper had power to make any such decision without application to Government. That was a matter for Government—to whom the idea of a bonus would most certainly be novel—and the decision would take time. Similarly a contractor could have got rid of his Chief Engineer at once. In this particular case the advice of Sir George Buchanan to replace Mr. Lewis was not acted on for two years.

A contractor is intensely concerned in daily cost and daily progress.

The Department had no costs accounting clerk. Sir George Buchanan pointed out its absolute necessity—the Government at first decided against it but ultimately acquiesced. No contractor would have gone on throughout a whole dredging season without ascertaining the result of the daily soundings.

A contractor having undertaken to produce a given result within an agreed time at an agreed price knows that his reputation and perhaps even his solvency depend on his personal watchfulness, drive and energy. The interest of a Government department in any particular scheme is far less concentrated, less individual, and less personal.

162. In our opinion a Local Government should not undertake schemes which are beyond the scope of ordinary Public Works Department work, but should in all cases adopt the first or second of the three courses suggested by Sir George Buchanan which are given above.

### Mr. Kidd and his 1912 Report.

163. We were greatly impressed by Mr. Kidd's evidence, and we believe that if the Government of Bombay had acted promptly upon his Report of 1912 and had entrusted the work to him, the reclamation would have been successfully carried out at about the price and within the time estimated by him. We need not dwell upon the advantages which thereby would have accrued to the City of Bombay.

### Dredging or Dry Filling?

164. Whilst the reclamation was a satisfactory dredging proposition in 1912, it certainly was not so in 1919. In the one case, the total estimated expenditure for dredging plant was £287,000, and in the other the cost of dredging plant, including the "Kalu," the "Jinga" and the pipe line, has been about £850,000. Between 1912 and 1919 there was a very large increase in prices of all machinery, cement and other materials required in the work, averaging somewhere between 2½ and 3 times the 1912 prices.

The cost of dredging, as it originally appeared in the 1919 report, was 8 annas per cubic yard for machinery and cost of working. The actual cost of the machinery alone, as supplied, came to even more than 8 annas per cubic yard, thus leaving nothing for working costs. The latter themselves have exceeded 8 annas per cubic yard. It follows that the minimum price for the reclamation by pumping would have been at least 1 rupee per cubic yard.

165. The price of dry filling in the 1919 report was 2 rupees per cubic yard. Actually, the cost, including plant should be little more than 1 rupee per cubic yard, and having regard to the fact that the moorum filling is far better suited for reclamation purposes, and required no time for drying out, it would have been a far better proposition not to have used the dredgers at all, but to have done the whole reclamation by moorum filling if transit facilities were available. It is even yet uncertain to what extent pumped mud will prove satisfactory as a foundation for roads.

Dry filling at 2 rupees was not a business proposition, but at a little over 1 rupee it would have been, and it is unfortunate that this method was not thoroughly investigated before it was decided to buy the dredging plant.

## V.—RECOMMENDATIONS REGARDING FUTURE OPERATIONS.

166. We have now completed those parts of the Report which deal with the inception and conduct of the scheme, and we turn to our recommendations for the future. At the request of the Government of Bombay we submitted, after our arrival in London on 11th September, an *ad interim* report containing our recommendations as to the steps that should be taken to ensure that work on the reclamation might proceed so far as necessary without interruption during the current working season pending the submission of the Committee's Report. The text of our report was as follows :—

> "Committee unanimously recommend reclamation of blocks 1, 2 and 8, block 1 by dredging from Back Bay in next working season and thereafter both blocks 1 and 2 by either dredging or dry filling, whichever may prove more economical

or advantageous. Dredger should work three shifts. Block 8 should be completed as quickly as possible by dry filling. Storm water drains 6 and 7 in blocks 1 and 2 should also be completed, and parapets in blocks 1 and 8 constructed in due course.

"2. With regard to block 7, the Committee note that its area is 654,000 square yards and that the quantity of dredged filling, exclusive of moorum topping, required to fill this block is 2,050,000 cubic yards. They consider that if the dredger is worked efficiently for three shifts daily, the block should be completed, so far as dredged material only is concerned, in the course of the season at a rate of 8 annas per cubic yard, and that this rate is much below the cost of any other method of filling at some future date. The cost of moorum topping, development, interest and depreciation has of course to be added to this. The Committee note also that the dredging plant is available on the spot and that the superior staff cannot be dispensed with without six months' notice. At the same time they are impressed with the uncertainty regarding the date and rates at which the land, if reclaimed, could be disposed of, and this makes them doubtful if it would be a sound proposition financially. They therefore consider that in the circumstances it is for the Local Government to decide for themselves whether any action, and if so what, should be taken in respect of this block pending the decisions of Government on the final report of the Committee.

"3. The Committee wish to emphasise the necessity of taking immediate steps to find new and nearer quarries for moorum and to arrange definitely for more abundant and speedier supplies at cheaper rates than at present.

"4. We have not been able to discuss the precise terms of this report with our Chairman, who is now en route from India, but understand that he is in agreement with the substance of our recommendations."

167. In this report we have endorsed the recommendations of Mr. Kay's Committee in favour of the completion of blocks 1, 2 and 8, and the Government of Bombay have taken into consideration the facts to which we drew their attention in regard to block 7, and have decided to complete that block also. Their reasons for taking this step are clearly set forth in their Press note, No. P 215, dated 16th October, 1926, which is reproduced in the Appendices. We would here only emphasise that, in our opinion, the completion of block 8 is the most urgent work of all, since the payment which the Indian Government will make when that block is handed over to them will have an important effect in reducing interest charges. The date of completion will, of course, depend upon the extent to which the pumped filling already done becomes sufficiently dry to carry the trains of moorum.

168. We now recommend that in addition to the completion of the four blocks 1, 2, 7 and 8 the foreshore portion along the middle blocks 3, 4, 5 and 6 should be filled to an average width of 300 feet seaward of the present shore-line and brought up to the ground level of the reclamation. Our proposals are illustrated in the plan which forms the frontispiece to our Report. The strip should be made to curve at both ends, so as to join on with block 2 at the northern and block 7 at the southern end when they are reclaimed. The considerations which have led us to make this recommendation are, firstly, that the unsightly appearance of the reclamation will be largely removed; secondly, the strip of 300 feet will afford facilities for a marine drive which would run from Marine Lines to Colaba; together with footpaths, roads, parks, playing fields and recreation grounds, and, whilst providing access to blocks 7 and 8, will undoubtedly increase the value of blocks 1 and 2; thirdly, a large area in blocks 1 and 2 which might otherwise be required for open spaces will be released for building sites, thereby contributing to a further reduction in the loss anticipated by Mr. Kay's Committee. Special care should be taken to complete the foreshore as speedily as possible, and to remove materials, stores and rolling stock from that area, so that the public may have access to and make full use of the sea front and promenade for purposes of recreation.

169. The areas to be reclaimed and the quantities of filling to be done in each of the four blocks and the connecting foreshore strip, comprising the first stage of the scheme, are given in the following table :—

| No. of block. | Area of land to be reclaimed. Lakhs. Sq. yards. | Total quantity of filling in four blocks and strip. Lakhs. Cubic yards. | Filling remaining to be done. Lakhs. Cubic yards. | Method of filling proposed. | |
|---|---|---|---|---|---|
| | | | | By Dredging. Lakhs. Cubic yards. | With Moorum. Lakhs. Cubic yards. |
| 1 | 4·37 | 18·38 | 12·60 | 10·33 | 2·27 |
| 2 | 4·98 | 26·06 | 20·50 | — | 20·50 |
| 7 | 6·54 | 27·79 | 27·79 | 20·50 | 7·29 |
| 8 | 11·11 | 39·10 | 7·53 | -- | 7·53 |
| foreshore strip. | 4·54 | 16·92 | 16·92 | — | 16·92 |
| | 31·54 | 128·25 | 85·54 | 30·83 | 54·51 |

Although the filling of block 2 as it appears in this table is contemplated to be done by moorum, the result of the dredging operations in Back Bay may be such as to justify a partial filling of this area by dredging.

170. We have considered the possibility of filling the foreshore strip which we have recommended with moorum in lieu of dredged material, and consider that this method would carry

with it certain definite advantages. Moorum is consolidated more rapidly than dredged material and the reclaimed land will be available for use at an earlier date. We have reason to believe that the railway companies will quote a price of Rs. 200 per thousand-ton train for 10 trains per day, if suitable arrangements for filling and unloading are made. By this method 1,800,000 cubic yards of dry filling could be obtained in a year of 240 working days. The moorum filling should be done by drag-line scrapers if there is any difficulty in doing it by hand, but the latter course is preferable, provided that a contractor can be found to do the work at a fair price.

171. A complete lay-out of the area to be reclaimed under the scheme now recommended should be prepared without delay The foreshore strip should be fully developed as soon as completed. Blocks 1, 2 and 7 should be developed gradually as the prepared land is taken up and there is demand for more. In this way the development will be gradual, the construction of roads, drains, &c., will proceed *pari passu* with the progress of land sales and no large outlay under the main head of development will remain unproductive. The lay-out already prepared for the complete scheme for reclaiming 1,145 acres should be examined and the plan (not necessarily the cost) finally approved with suitable modifications. The two lay-outs should be made to fit into one another so that whatever development is now carried out may ultimately form part of the entire scheme, and be furthering its intentions. It would be an advantage if both these lay-outs are scrutinized by a Committee of Engineers and businessmen before they are finally approved by Government. The absence of such final approval has in the past led to delay in the alignment of storm water drains, &c., and to waste of money.

172. As the area is developed and buildings spring up, the Municipal Corporation of Bombay will be levying house, water and sewerage taxes or rates, and in the fitness of things that body should share a portion of the cost of development. It is presumed that the cost of the water supply mains will be borne entirely and that of the sewerage mains at least partly by the Corporation. It is suggested that these questions be taken up and settled promptly, and in the case of questions which cannot be decided immediately the principles which should guide such future settlement may be clearly laid down.

173. A clear settlement or understanding between the Government and the Corporation in regard to their respective financial responsibilities will be of material help in the speedy solution of all problems leading to the development of the reclaimed area.

174. It is expected that the "Sir George Lloyd" and the "Colaba" will complete block 7 before the end of the season. We assume that during the current season a much greater output will be realised by all the dredgers. The work done should be checked daily by soundings, and the quantities of work done measured up daily. Substantial bonuses should be paid to the

staff on the output. At the end of the present dredging season Government should make the closest estimate of the cost incurred in reclaiming blocks 1 and 2 by dredging, and should satisfy themselves as to the character of the land reclaimed. If it should happen that the cost approximates to that of moorum, and the quality of the reclaimed land is found satisfactory, they should consider the advisability of continuing dredging operations in conjunction with moorum filling into blocks 1 and 2. After the end of the present season if the cost is too high, or the character of the land unsuitable, the use of the dredgers should be discontinued, and an attempt should be made to dispose of the dredging plant. It should be possible, if careful soundings are taken, to come to a decision by the end of March as to whether the services of the staff should be retained. It is important that no steps should be taken that might lead the trained staff to seek employment elsewhere until Government have come to a decision on this point. We are aware that six months' notice is required under the contract of these officers, but consider that it would be better to face some loss in this respect than to give notice, even provisionally, before the results of the dredging during the current season are known.

175. We are of opinion that the reclamation should be removed from the control of the Development Directorate. The existing organisation, however, should be disturbed as little as possible. The majority of the Committee are of opinion that the control of the reclamation should be placed in the hands of Mr. Elgee, as Chief Engineer, who should work directly under Government, and communicate with the Member of Council responsible through the Secretary in the Development Department who, in this branch of his duties, should not be subordinate to the Director of Development. Sir M. Visvesvaraya, however, who has had a life-long experience of the working of the Public Works Department, is of opinion that the future interests of the reclamation would be more efficiently safeguarded by placing the work under the supervision of the Public Works Department. We are, however, all of opinion that whichever plan be adopted a small committee of five or six members, including one or two experienced engineers of the Public Works Department, should be constituted to advise Government on all important matters which are referred to them for their opinion. In so far as the reclamation is concerned, this Committee will assume the duties hitherto performed by the Advisory Committee attached to the Development Directorate. The arrangements we have suggested should continue so long as the progress of the work is satisfactory.

176. We advise that the work in future should be carried out, as far as possible, by contract agency. If a single contractor cannot be found to undertake the work at a reasonable price, it might be divided into sections, and contracts placed with separate individuals or firms after inviting tenders. In par-

ticular, it is desirable that a responsible contractor should be found to undertake all work in connection with the moorum filling, viz., the filling at Kandivli or elsewhere, the use of the necessary plant at the quarry, the payment of the railway companies for freight at such rate as may be agreed upon, the haulage, unloading and spreading of the filling at the site of the reclamation, upkeep of the roads, etc. Before handing over the plant to the contractor for use in the work, it should be jointly surveyed by him and the Government, and careful notes made of its condition, and the contractor should be made responsible for returning the plant to Government in as good condition at the conclusion of his contract, fair wear and tear excepted. The price for filling in the quarries should be per cubic yard in the solid before digging. Similarly, work in connection with the storm water drains should be given out to a contractor, and he should be required to supply all necessary material and labour and any additional plant that may be needed. The blocks already cast should, of course, be utilised wherever they are of suitable size.

177. The expenditure incurred up to the 30th June, 1926, was in round figures, 468 lakhs. To this may be added the estimated cost of completing the scheme indicated in the plan forming the frontispiece, viz., Rs. 135 lakhs. The total expenditure, therefore, without reckoning interest charges or depreciation, will be 603 lakhs, or, if 33 lakhs is deducted as the proceeds of the sale of the dredgers and plant, 570 lakhs net less of course the 256 lakhs receivable from the Military Authorities. The Development Department estimate that the whole scheme can be completed for 1,000 lakhs, but we regard this estimate, like others put forward by the same authority, with distrust. As the cost of the work which we propose is necessarily a matter of individual opinion, we append alternative estimates marked A and B. In estimate A a sum of 20 lakhs has been appropriated to the gradual development of reclaimed areas, and this sum should suffice for about 700,000 square yards. If the work is carried out with ordinary efficiency and diligence, the prices quoted in estimate A are likely to be in excess of the cost. The figure of Estimate B should be attainable under favourable conditions if the maximum of efficiency is achieved. We fully appreciate that in submitting our recommendation that blocks 1, 2, 7 and 8 and the foreshore strip should be completed we are going perhaps even further than public opinion will approve, but we put forward the proposal in the belief that this work is imperatively necessary and will prove of great advantage to the City. Also we are strongly of opinion that the material advantages and amenities, especially of blocks 1 and 2, will become so apparent that there will arise a brisk demand for land in that most advantageous position. We have prepared, but do not submit, detailed estimates showing that the extension of the 300-foot strip to a further distance seaward of 400 feet, making a total width of

700 feet, could be effected at under Rs. 7 per square yard, and a further strip of 300 feet, which would result in widening the reclaimed strip to 1,000 feet, could be done for Rs. 8½ per square yard. We have also prepared, but do not append, an estimate for the reclamation of the entire area which covers a total area of 4,259,000 square yards. This shows that such area on the same basis of the most favourable conditions of working and the maximum of efficiency, ought to be reclaimable at the rate of Rs. 14 per square yard, including development and past expenditure. This figure is for the total area, making no allowance for roads, open spaces and other unproductive areas. It is not suggested that these additional strips should be reclaimed at present, but we think that in future, when prosperity returns to Bombay, the demand for land will make it practicable to undertake further gradual reclamation on these lines. If more land is now reclaimed than we have recommended there will be no immediate demand for it, save for use as open spaces, while as the work is being constructed with borrowed money it would entail an addition to the unproductive debt. We have omitted interest and sinking fund charges from the appended estimates because we are treating the matter on the basis that the money already spent has been substantially lost and because the obligation to pay interest on this amount is one that has to be met yearly from the public revenues. When, however, the military authorities pay 256 lakhs for block 8, the net loss on the work already done—that necessary to complete block 8—will be reduced to 219 lakhs and we believe that the proceeds of sales of land in blocks 1, 2, and 7 will further appreciably reduce this loss. We have not attempted to work out any tables corresponding to those prepared by Mr. Kay's Committee on the hypothesis that a certain amount of land can be sold yearly or that a certain average price can be realised for it; the disposal of the land reclaimed and its price depend on so many uncertain factors that we think that no useful purpose would be served by any forecast which we could frame. The evidence before us is conclusive that blocks 1 and 2 are the most valuable in the whole project, and we recommend that they should be completed as early as possible. No part of these blocks should be assigned for recreation purposes, the needs of which can, we hope, be met by the curved strip which we have recommended along the foreshore. These blocks should be laid out in a strictly commercial spirit, and the plans of development should be re-examined with a view to increasing the area available for sale to the public and to producing the largest possible financial return.

ESTIMATE A (excluding interest).
(Rs. Lakhs.)

*Blocks 1, 2, 7, and 8, and 300 feet wide strip in front of Blocks 3, 4, 5, and 6 as shown on Plan.*

*Estimate for completion to Surface only, and not including Development except so far as the 300 feet Strip is concerned.*

| No. of block. | Cost of dredged filling. | Cost of moorum filling. | Storm water, drains, parapets, &c. | Total estimated cost. | Remarks. |
|---|---|---|---|---|---|
| 1 | 10.33 | 2.55 | 2.80 | 15.68 | |
| 2 | — | 23.06 | 3.03 | 26.09 | |
| 7 | 15.38 | 8.20 | 2.55 | 26.13 | |
| 8 | — | 8.47 | 1.28 | 9.75 | |
| Foreshore strip. | — | 19.04 | 7.33 | 26.37 | Includes cost of development. |
| | 25.71 | 61.32 | 16.99 | 104.02 | |

| | | |
|---|---|---|
| Works proper as above ... ... ... ... ... ... | | Rs. 104.02 lakhs. |
| Add 10 per cent. for establishment and contingencies ... | | 10.40 |
| | | 114.42 |
| Initial grant for gradual development of reclaimed areas ... | | 20.00 |
| Total ... | | 134.42 or, say, 135. |

ESTIMATE B (excluding Interest).

*Blocks 1, 2, 7, and 8, and 300 feet wide strip in front of Blocks 3, 4, 5, and 6 as shown on Plan.*

*Estimate for completion to Surface only, and not including Development except so far as the 300 feet Strip is concerned.*

| | | | | |
|---|---|---|---|---|
| BLOCK 8. | | | | |
| 753,332 c. yds. | Moorum Filling *in situ* in Reclamation ... ... | 1 R. | | 7.53.332 |
| | *No Parapet.* | | | |
| BLOCK 7. | | | | |
| 728,700 c. yds. | Moorum Filling ... ... | 1 R. | 7.28.700 | |
| 2,050,000 „ | Dredged Filling ... ... | 7 A. | 8.96.875 | |
| | Storm water drains, including all charges: | | | |
| | Mr. Elgee's Estimate ... | 2.79.633 | | |
| | — 25% ... ... | 69.908 | | |
| | | | 2.09.725 | |
| | Parapet — Mr. Elgee's Estimate, less 25% ... | | 45.344 | |
| | | | | 18.80.644 |
| BLOCK 1. | | | | |
| 226,700 c. yds. | Filling by lorries and moorum ... ... | 1 R. | 2.26.700 | |
| 1,033,400 „ | Dredged Filling from Back Bay, say ... ... | 12 A. | 7.75.050 | |
| | Parapet — Mr. Elgee's Estimate, less 25% ... | | 75.559 | |
| | Storm water drains do. | | 2.03.955 | |
| | | | | 12.81.264 |
| BLOCK 2. | | | | |
| 372,000 c. yds. | Moorum Filling ... ... | 1 R. | 3.72.000 | |
| 1,678,050 „ | Dredged Filling ... ... | 12 A. | 12.58.537 | |
| | Parapet — Mr. Elgee's Estimate, less 25% ... | | 26.316 | |
| | Storm water drains do. | | 2.76.732 | |
| | | | | 19.33.585 |
| | *Carried forward* ... ... ... ... ... | | | Rs.58.48.825 |

*Strip 300 feet wide in front of Blocks 3, 4, 5 and 6, as Shown on Plan.*

| | | | | |
|---|---|---|---|---|
| *Brought forward* ... ... ... ... ... ... | | | | Rs. 58.48.825 |
| 1,691,613 c. yds. | Moorum filling ... ... | 1 R. 16.91.613 | | |
| | Storm water drain No. 5, Mr Elgee's Estimate, *less* 25 per cent. ... | 34.125 | | |
| | Development 100-ft. road foot paths, lighting, etc., Mr. Elgee's Estimate, *less* 25 per cent. ... | 5.15.458 | | |
| | | | | 22.41.196 |
| | | | | 80.90.021 |
| | *Add*—6¼ per cent. Establishment Charges, but taking no credit for value of plant on completion. | | | 5.05 610 |
| | | | | Rs. 85.95.631 |
| | Development 1, 2 and 7 Blocks ... ... ... | 40.37.034 | | |
| | *Less*—25 per cent. (for over-estimating) ... | 10.09.258 | | |
| | | 30.27.776 | | |

*Assuming that only the first stage is completed, i.e., Blocks 1, 2, 7 and 8, plus the 300 feet strip in front of Blocks 3, 4, 5 and 6, the position is as follows :—*

| | Rs. |
|---|---|
| Cost of completing these blocks and strip ... ... ... ... | 85.95.381 |
| Development of Blocks 1, 2 and 7 ... ... ... ... | 30.27.776 |
| Cost to 30th June, 1926 ... ... ... ... ... ... | 468.05.764 |
| | 584 28.921 |
| *Less*—Amount from Indian Government ... ... | 256.52.000 |
| | Rs. 327.76.921 |

For this the Government will get :—

| | | |
|---|---|---|
| Block 1 ... ... | 436,767 sq. yds. | |
| „ 2 ... ... | 496,478 „ | |
| „ 7 ... ... | 654,433 „ | |
| Strip ... ... | 454,444 „ | |
| = 422 Acres | 2,042,122 | = 16.05 Rs per sq. yd |

178. Before commencing any of the works not already specifically sanctioned for the current working season, it is suggested that complete estimates be prepared, together with detailed plans and specifications for the work. Such further surveys as may be necessary for these estimates may be put in hand at once. Works under all heads of estimates may be proceeded with after proper detailed estimates and programmes are prepared, and the formal sanction of Government accorded thereto.

179. It may be remarked in passing that some of the forms of tender laying down conditions of contract and specifications issued

by the Development Department have not been happily conceived, and are not calculated to promote the object in view. The conditions and restrictions laid down are too numerous or too rigid to permit of any prudent contractor undertaking the work. We should invite attention to the unsuitability of the tender form headed " Instructions to Tenderers " issued by the Department in 1926 for the supply of moorum, a printed copy of which was given to us by the Department.

180. We consider that every endeavour should be made to complete the scheme we have proposed within three or four years. By completing it expeditiously and closing the expenditure side of the capital account, the land reclaimed will be placed on the market and the amount of debt will be circumscribed, and there will be a reasonable prospect of recouping some of the losses incurred at an early date. The establishment charges will be also appreciably reduced if the work is carried out more expeditiously than is contemplated in Mr. Kay's Committee's Report. Sooner or later a time will come when there will be demand for completing this reclamation either because it will be profitable to do so, or on account of the need for extension as a part of the general development of the City. When this comes about, the reclamation may be taken in hand by moorum filling exclusively. It will be possible to transport moorum from Salsette to the works site, without materially interfering with the traffic or the use of the foreshore, and with moorum filling the work will be free from difficulties and uncertainties.

### The Hon'ble Mr. Cowasji Jehangir.

181. During this period Mr. Cowasji Jehangir's position was one of great difficulty. He had to sponsor a scheme decided on before he assumed office, and as regards which he must have found it difficult to get exact information. We express our admiration of the manner in which he carried out his duties and for the clearness and frankness with which he dealt with a tangled situation. We acknowledge also the assistance which he gave to the Committee and his manifest desire that every information should be supplied to us.

### Sir George Buchanan's Statement.

182. Sir George Buchanan prepared a very lengthy statement for the use of the Committee and, also during the course of his six days' examination, put in many other documents and subsidiary statements.

Having regard to the immense amount of detail in the case, and to the seriousness of the issues, he asked the Committee to allow him to be represented by Counsel, whose principal duty should be to ensure that at some time or another all the points which Sir George Buchanan wished to make were put

before the Committee. The request was a reasonable one, and it having been granted, Sir Harry Courthope-Munroe, K.C., and Mr. Melville attended on his behalf.

In the course of the examination we invited Sir Harry Courthope-Munroe to address us on the construction of the Agreement of the 17th March, 1921, and we express our indebtedness to him for his argument.

183. Sir George Buchanan's statement is a very important document, and we have incorporated some material passages from it in this Report.

We have not been able always to accept Sir George Buchanan's point of view, and indeed we have found ourselves compelled to attribute a considerable portion of the failure of the scheme to him. He made his view of the position perfectly clear to us—which was that from first to last he had in all respects done his duty—that he could not be answerable and was not in fact answerable for the conduct of the work—that no great undertaking of this character can ever proceed in all respects according to programme and that " it is easy to be wise after the event." There is force in this latter criticism, and before arriving at our conclusions the question which we have asked ourselves as regards all the principal persons connected with the inception of the scheme is —did they with such knowledge as they had and such information as was available to them give that degree of care, attention and thought to the subject as they were in duty bound to do?

184. With regard to those responsible during the conduct of the work, whether for supervision, advice, assistance, control or actual execution, we have asked ourselves if they exercised all proper skill, care, energy, foresight and diligence.

185. Before stating our conclusions we express our obligation to the Government of India and the Government of Bombay for the completeness of the official documents prepared for our use. There has been no instance either in India or in England in which a request for official information or documents has not been readily and speedily complied with and we are satisfied that to no Committee could more consideration have been given.

186. We also express our obligation to the witnesses who came forward, both in India and England, and whose evidence has in all cases been of material help to us.

187. We congratulate Mr. Norman and Mr. Cooper for their great skill in taking down the evidence in shorthand and the unusual accuracy of their script. In Bombay the work was not well done.

### Mr. Ewbank's Help.

188. We are under a debt of gratitude to the Government of India for giving us Mr. Ewbank as our Secretary. His efficiency,

has been beyond praise. On no occasion has there been the slightest breakdown in even the smallest arrangements, and our work has been greatly facilitated by his knowledge of the documents and the precision of his business methods. We tender our thanks to him for services so exceptional.

## General Summary.

189. The object of the Back Bay Reclamation Scheme was, as we have already said, to reclaim from the sea an area of 1,145 acres at an estimated outlay of about Rs. 367 lakhs. Government were prepared to spend on the scheme up to Rs. 400 lakhs if necessary. A revised estimate for Rs. 702 lakhs was approved within two years of the original sanction, and if the scheme is to be completed, a second revision of the estimate will be necessary. The total cost will approximate to about 900 lakhs gross, exclusive of interest charges. This total sum will be reduced by the 256 lakhs to be received from the Military authorities and any other subsequent receipts from sales of land. The programme of the reclamation, which was to have been completed by 1926-27, has completely broken down. If it is continued under present conditions it cannot be finished for many years to come.

190. It is believed that land reclaimed cannot in the near future be sold at remunerative prices, and care should be exercised not to reclaim land in advance of the demand. The work is being constructed from public loans on which interest and sinking fund charges have to be met and Government are faced with a growing debt.

191. The difficulties in which the scheme is at present involved arise from :—

(1) the unsatisfactory character of the estimates;
(2) defective organisation;
(3) the failure of the dredging operations; and
(4) the fall in land values.

192. The defects in the various estimates would have been avoided if there had been sufficient and careful preliminary investigation. If an alternative comparative estimate for dry filling had been prepared at the outset and the cost of adequate dredging plant properly investigated, Government might have hesitated to commit themselves to the use of suction dredgers for this scheme. A dredging scheme costing Rs. 400 lakhs was an attractive financial propostion, but it might very well be considered to have changed its character when the cost went up to 702 lakhs. Reclamation by dry filling, if then practicable, might have proved cheaper.

193. As regards the organisation and arrangements made for the conduct of the scheme, these in themselves were almost unworkable. A reading of clause 3 of the agreement between the

Secretary of State in Council and the firm of Meik and Buchanan shows that responsibility was not clearly defined between the Engineers and the Director of Development. Much of the technical work was left to an overworked Chief Engineer or was not done at all. There was no costing system, without which it was impossible properly to control expenditure.

194. Because nobody believed himself responsible for the due execution of the work, unwise decisions were taken and mistakes made, such, for instance, as commencing the construction of the sea wall from both ends, delay in sealing the rubble mound, undertaking dredging operations in Back Bay without consideration of cost, absence of preconcerted programmes to regulate operations, etc. All these militated against the success of the scheme and added to its cost.

195. The inability of the dredger to give the required output has been the chief cause of failure and has had a disastrous effect on the financial prospects of the scheme. The principal reason for the present serious position of the scheme was the ordering of the dredger on estimates and specifications put forward by Messrs. Simons and Company which were not examined with due care, the absence of proper guarantees for the sufficient output of the dredger and the acceptance of a quotation for a dredging plant without any real effort to secure competitive tenders.

196. The work having been undertaken in anticipation of realising large profits, the scheme was subjected to very great criticism when a period of acute trade depression set in with a consequent fall in land values. The trade depression was not a matter which could have been foreseen, although caution was necessary in undertaking a scheme of this magnitude at a time when world conditions were unstable. With the disappearance of the prospect of profits public criticism concentrated on the defects of the scheme.

### Summary of Recommendations for the Future.

197. With regard to future operations, the following is a summary of the recommendations which we have made :—

(i) For financial reasons the completion of block 8 is a most urgent work.

(ii) The foreshore portion along blocks 3, 4, 5 and 6 should be filled in to an average width of 300 feet seaward of the present shore-line and brought up to the ground level of the reclamation. The strip should curve at both ends, so as to join on with block 2 at the northern and block 7 at the southern end. This should be done as speedily as possible.

(iii) The foreshore strip should be reclaimed with moorum filling.

(iv) A complete lay-out of the area to be reclaimed should be prepared. The foreshore strip should be developed as soon as completed and blocks 1, 2 and 7 gradually as land is taken up.

The lay-out already prepared for the complete scheme (1,145 acres) should be re-examined with the help of a Committee; and the lay-out of the area now recommended for reclamation should fit in with the lay-out approved for the complete reclamation, if ultimately undertaken.

(v) The Corporation of Bombay should share the cost of development, and Government should arrive at an understanding with the Corporation on this point.

(vi) The results of the work of the " Sir George Lloyd " and the " Colaba " during the current season should be verified. If the cost of filling by dredging approximates to that of moorum and the quality of the reclaimed land is satisfactory, they might be used for blocks 1 and 2 after block 7 is completed. If not, they should be disposed of. Notice should not be given to the staff until this point is decided.

(vii) The reclamation should be removed from the control of the Development Directorate and carried out in accordance with one or other of the plans suggested in the report. A small committee, including one or two experienced engineers, should be constituted to advise Government on matters referred to them.

(viii) The work should in future, as far as possible, be carried out by contract agency.

(ix) Alternative estimates of the cost of the scheme now proposed are submitted. The extension of the 300-foot foreshore strip by additional strips of 400 feet and 300 feet, as need arises, is contemplated. Blocks 1 and 2, as being the most valuable in the whole project, should be completed as soon as possible. No part of them should be assigned for recreation purposes.

(x) Detailed revised estimates should be prepared at once. The form of tender issued by the Development Directorate should be revised.

(xi) Every endeavour should be made to complete the scheme proposed in three or four years. When a demand arises for completing the whole reclamation, the work may be carried out by moorum filling exclusively.

## VI.—CONCLUSIONS.

198. Lord Lloyd left England charged by Mr. Montagu to take urgent steps to improve the housing conditions of Bombay. Whilst that did not necessarily imply the undertaking of a reclamation scheme, reclamation had nevertheless been considered for

many years to be an integral part of any comprehensive scheme for the betterment of conditions. We are satisfied from the evidence that Mr. Montagu was deeply interested in the Reclamation, and wished it to be carried through. We think that Lord Lloyd and the Government of Bombay were justified in accepting Sir George Buchanan as an expert to report on Mr. Kidd's scheme, and that having taken the man recommended by the Government of India, the proper and prudent course was to treat his opinion as final and authoritative.

199. Lord Lloyd's letter of 25th May, 1919, shows conclusively that he had no predilection for a reclamation scheme, and that he was prepared to abandon it at once had Sir George Buchanan reported adversely on it.

200. Though we are aware that a Governor must necessarily rely upon his advisers for the details of any particular scheme, yet having regard to the personal interest displayed by Lord Lloyd, as disclosed by his evidence and that of Sir George Buchanan, we are surprised that his acute intelligence overlooked the apparent inadequacy of Sir George Buchanan's figures, even though he held the belief that the 1912 figures of Mr. Kidd were to some extent inflated. In his Report, Sir George Buchanan himself gave 241·90 lakhs as the figure which he would have estimated in 1912, and on that basis the work could not have been done by him in 1919 for less than 605 lakhs.

201. To a lesser extent we are surprised that Lord Lloyd, when reading Sir George Buchanan's report, did not notice that Sir George Buchanan described the clay as hard, whilst Messrs. Simons & Co. were putting forward an offer for a soft clay dredger.

202. We do not agree with Lord Lloyd that this was a technical point. The explanation may be a technical one, but the discovery of the apparent contradiction between the character of the clay as described by Sir George Buchanan and Messrs. Simons & Co. needed no technical knowledge. It stood out on the document and was, unless satisfactorily explained, a contradiction in terms.

203. We are satisfied that Lord Lloyd acted throughout with the highest motives, anxious only to make good his undertaking to Mr. Montagu and to benefit the City of Bombay.

204. Sir George Curtis, who is living at Dinard, was too ill to attend. He has, however, furnished answers to certain questions which were sent to him. Although he was the Member in Charge during the inception of the scheme he has not been able at this distance of time to give us any information of value, and he cannot enlighten us at all as to the reason why no one in the Government of Bombay queried the varying descriptions of clay or compared the estimates of Mr. Kidd and Sir George Buchanan with reference to 1912 and 1919 prices.

205. We cannot understand how Sir George Buchanan's figures found acceptance in Bombay and Delhi even with the addition of some 10 per cent. It was common knowledge that prices of plant, material and labour, when taken collectively had gone up at least 2½ times in the period between 1912 and 1919. The 1912 figure of Mr. Kidd—325·23 lakhs—had been accepted both by the Government of Bombay and the Government of India as a fair figure. If that was the belief, then 367·61 lakhs was a manifest underestimate, and proper scrutiny would infallibly have demonstrated it. When Sir George Buchanan was being questioned on these two sets of figures by the Committee, and the rise in prices and the inevitable inferences arising from them, he " preferred " not to answer the questions.

206. The failure of the Government of Bombay and the Government of India, and in particular the failure of Sir Sydney Crookshank, to notice the varying descriptions of clay contained in (*a*) Mr. Kidd's Report, (*b*) Sir George Buchanan's Report, (*c*) Messrs. Simons & Co.'s letter of 12th September, 1919, and the " general conditions " enclosed with that letter are regrettable.

207. The reports of Mr. Kidd and of Sir George Buchanan were not studied with due and proper care by the Bombay Government and the Government of India respectively.

208. The Government of Bombay ought to have approached the Port Trust and the Royal Indian Marine for permission to dredge in the Harbour before deciding on dredging as the mode of reclamation.

209. We consider that Sir George Buchanan ought to have made far more extended and careful local investigations. These occupied him for less than a fortnight in May, 1919

210. He knew that the Port Trust had had " difficulties " with the dredgers " Kalu " and " Jinga " built by Messrs. Simons & Co. He ought to have made specific inquiries about this, but he did not do so. Mr. Messent, the engineer to the Port Trust, gave him at some time the pamphlet entitled " Some results of the working of the 'Jinga' and 'Kalu.' " A table of figures in that document showed that the average of both vessels was 1,126 cubic yards per hour as compared with 2,000 cubic yards per hour guaranteed and achieved on test. So little attention did Sir George Buchanan pay to this document that at first he said he had never seen it and knew nothing of the figures. A few days later he informed the Committee that he had found a copy of the document and that, as it bore Mr. Messent's initials, he no doubt got it from him.

211. In his letter of 25th July, 1919, to Messrs. Simons and Company, he wanted "your guarantee that the plant will do the work required." He did not get it. He wanted also a dredger " with a minimum capacity of 2,000 cubic yards of clay per

hour." He did not get it. On the contrary, he ultimately accepted a specification in which these two most necessary stipulations were omitted.

212. Not having studied Mr. Messent's publication, he held the unfounded belief (which a careful reading of Mr. Messent's document would have dissipated) that the results of the work of the " Kalu " and " Jinga " justified him in specifying the same output per hour on test for the " Sir George Lloyd."

213. Messrs. Simons and Company, through their representative Mr. McMurray, were well aware that hard clay existed in Bombay Harbour. Partly for that reason they refused a test on site. They suggested a dredger designed for soft clay but gave no guarantee that it would do the required work or give a minimum output of 2,000 cubic yards per hour. In drafting their offer of 12th September, 1919, we think they were more concerned in protecting themselves than in supplying a dredger fit for the known purpose for which it was going to be used. Accepting Mr. McMurray's own account of the interviews of July and August, 1919, we disapprove of his attitude and of that of his firm. Sir George Buchanan accepted any conditions they made, because he had the fixed belief that the harbour reclamation was in all respects the same problem as the Sewri, and because of his erroneous belief in the capacity of the " Kalu " and " Jinga."

214. The capacity of the dredger was much too low, and a guarantee of an output of soft clay " at the rate of " 2,000 cubic yards per hour on test meant infallibly an output under ordinary working conditions of much less. The position seems ultimately to have been appreciated by Sir George Buchanan, who, in his report of 15th December, 1924, thought it " improbable with the class of material now being taken from the harbour that the ' Sir George Lloyd ' will do her estimated output of five million cubic yards per annum." In the same report he said " if we get two-thirds of the total output we shall be doing well."

Having regard to the great initial outlay and the need for speedy realisation, the time within which the work would be completed was an element of the highest importance.

215. We are convinced that no crew, however skilful and diligent, ever can or will get anything like five million cubic yards of material from the Harbour in any one season by the agency of the " Sir George Lloyd." In a deep bed of soft clay they probably would get from time to time material at the rate of 2,000 cubic yards per hour. The first two reasons given by Mr. Halcrow in his report and set out in the body of this document are conclusive against the possibility of any continuous happening of this kind. The material on the average is too stiff, the depth of material uncertain, the bed of the sea uneven, with uprocpping rock, stones and moorum, the capacity of the dredger too low.

216. Whilst we are of opinion that the " Sir George Lloyd " would under test conditions have delivered 2,000 cubic yards of

soft clay per hour, and therefore conformed to the building contract, we are opinion that the " Colaba " did not do so, and that she was structurally weak. In our view she ought to have been stiff enough to take any variation in load without sustaining damage by vibration.

217. In November, 1919, Sir George Buchanan, being in ignorance of the quality and characteristics of the silt or mud and clay in the harbour, ought, as a measure of prudence, to have advised the Government of Bombay that no decision should be come to to treat the reclamation as a dredging problem until check borings had been taken to ascertain the density, depth and resistance of the silt or mud and clay in various parts of the harbour, and also that it was essential to ascertain by experiment whether the material obtained from the bed of the sea would dry out when deposited in an area under reclamation. Certainty on these points could have been arrived at by December, 1919, and the check borings were all the more necessary as Messrs. Simons had at this time definitely refused a test at Bombay.

218. With regard to the order for the dredger we consider Sir George Buchanan committed grave errors of judgment. The principal cause of the failure of the dredging operations arose, in our opinion, from the fact that Sir George Buchanan did not take the trouble to ascertain the working records of the " Kalu " and " Jinga," and believing that they had done " extraordinarily good work " was of opinion that vessels of a slightly increased horse-power of the same type would be adequate for the work. A most serious mistake in connection with the order of the dredger was the assumption that a machine capable of dredging 2,000 cubic yards on a short test would be capable of averaging that quantity during a whole season.

219. The building of the sea wall at both ends simultaneously was disastrous. Though the suggestion emanated from the Government of Bombay, who must therefore take the greater part of the responsibility, we are of opinion that Sir George Buchanan should have advised against it, and resisted it, and should in the circumstances of the sale of Block 8 to the Military have prepared a programme for the building of the wall and the commencement of the Reclamation from the Colaba end only.

220. Moreover, the building of the sea wall from both ends simultaneously prevented the continuance of the original and sensible plan which was to shut in an area as soon as possible and pump into it with the least possible delay.

221. We are quite unable to accept the theory set up by Sir George Buchanan that the phrases " soft clay " and " stiff clay " as used by him connoted the same density of material. Also we cannot accept his explanation that where he uses the words " hard clay " or " closely compacted clay " or other equivalent

phrase, he meant, not that it was hard in its position in the harbour, but that it was of a character which would become hard when pumped into the reclamation.

222. The firm of Messrs. Meik and Buchanan did not prepare proper programmes of work nor adhere to any fixed programme. The reason of their indecision with regard to the dredging was due partly to the limitation of area by the Port Trust and Royal Indian Marine (for which neither the firm nor Sir George Buchanan can be held accountable), but principally to the fact that, having no certain belief in the quality of the material in the harbour, they were unable to formulate proper and precise future plans.

223. Sir George Buchanan did not realise that he was the expert to whom from first to last the Government looked for advice and assistance. He did not appreciate that when he found causes for complaint it was his duty to require them to be remedied, and in virtue of his responsibility for supervision to see that they were remedied. In his evidence he ascribed to himself a position of no power, weight or importance, and he allowed his opinion to be disregarded. We think that this was an entire misconception of his position, and he never ought to have allowed his advice to be set on one side. On such occasions as this happened he should at once have realised his duty to the Government of Bombay and assisted them by making the facts known to them, and we can have no doubt that Lord Lloyd and Sir Leslie Wilson would have welcomed information and would have given all help and encouragement to Sir George Buchanan in any effort made by him to advance the work.

224. The agreement of the 17th March, 1921, between the firm of Meik and Buchanan and the Secretary of State for India in Council was an unhappily framed document. Clause 3 gave Sir Lawless Hepper the opportunity of saying that as the Resident Engineer had to carry out the details of the work in accordance with the firm's instructions, that therefore the firm were responsible for the due execution of the works. On the other hand, Sir George Buchanan naturally pointed to the sentence, also in Clause 3, that the Resident Engineer should be "subject to the control of the Director of Development." From this arose a mutual misunderstanding. Thus from the outset neither Sir George Buchanan nor Sir Lawless Hepper seemed to have a very clearly defined idea of their respective duties. Later, when the disaster was threatening the enterprise, each relied upon his interpretation of the agreement. Sir Lawless Hepper, when giving evidence, insisted before us that Sir George Buchanan was entirely responsible for the due execution of the works, as if he were, in fact, a contractor who had undertaken them. On the other hand, Sir George Buchanan contended that that responsibility lay with Sir Lawless Hepper, pointing out that he it was who had control of the Resident

Engineer, and that his firm has no power of dismissal over any of the staff. On the strict construction of the agreement we incline to the opinion that Sir George Buchanan is right, although there are statements of his to be found in his correspondence which would bear the interpretation that he did regard his firm as responsible for the actual carrying out of the works.

225. If the Government of Bombay intended to make Sir George Buchanan's firm responsible for the execution of the works, nothing was easier than to say so in plain and simple words, and as a necessary corollary to put the Resident Engineer entirely under the control of his firm, including the power of appointment and the power of dismissal. The provision that the Government of Bombay should pay the Resident Engineer would not have detracted from a provision that the firm should be responsible for the due execution of the work, nor from the legal position that the Resident Engineer would have been the servant and agent of Sir George Buchanan. In that way the position of Sir George Buchanan and Sir Lawless Hepper would have been perfectly clearly defined.

226. The reports of the Development Directorate, drafted by Sir Lawless Hepper, cannot be justified. They did not present a true picture of the progress of the work and concealed material circumstances.

227. We are of opinion that Sir Lawless Hepper had so much work in connection with the other Development Schemes that even if he had appreciated his responsibility for the execution of the works he could only have carried out that duty as regards the Reclamation by neglecting other duties relating to the other schemes.

228. Mr. Lewis was not a " specialist in sea works and dredging " ; Sir George Buchanan ought not to have nominated him. He was, however, greatly handicapped by the necessity of preparing a detailed project estimate, and this so absorbed his energies that he was unable to devote himself fully to supervising and pushing on the work. Very shortly after he became Resident Engineer we are satisfied that he was in ill health which became manifest and disabling in 1922. It is most regrettable that he was allowed (contrary to Sir George Buchanan's advice) to remain at his post till July, 1924.

229. We are of opinion that Mr. Elgee, Mr. O'Rorke, and Mr. Speirs have done their best on all occasions to promote the interests of the Reclamation, and that the quarry, constructional and dredging staff have done their duty.

230. It has been put forward that the Reclamation of Back Bay would, by providing more land in the business and residential area, in some way relieve housing conditions of the poorer classes.

That, in our opinion, is too remote for serious consideration, but, had Back Bay proved to be the financial success which was anticipated, the advantage to all classes of persons in the City and throughout the Presidency would have been that there would have been available immense sums of money to be used for any purpose pleasing to the legislative Council. The confident anticipation of profits had no doubt considerable weight in causing the reclamation of Back Bay to be accepted as an integral and necessary part of any comprehensive plan of development.

GRIMWOOD MEARS.
M. VISVESVARAYA.
F. T. HOPKINSON.
S. B. BILLIMORIA.

1st December, 1926.
Whitehall, S.W.1.

# APPENDIX.

16, Victoria Street,
Westminster, London, S.W.
September, 1919.

From

Sir GEORGE BUCHANAN, K.C.I.E.;

To

The JOINT SECRETARY to the GOVERNMENT of BOMBAY,
Public Works Department.

SIR,

BACK BAY RECLAMATION SCHEME.

In accordance with the instructions received in your letter No. B.-6142 dated 30th May, 1919, I have the honour to submit the following report on the scheme prepared by Mr. Kidd, of Messrs. Lowther, Kidd & Co., for the reclamation of 1,145 acres in the Back Bay, Bombay, known as the 1912 Project.

2. *Terms of reference.*—The specific points on which my opinion is required are:—

(1) The practicability of the scheme from the engineering point of view.

(2) The suitability of the type of wall proposed, or alternate suggestions for better types.

(3) The suitability of the proposed method of reclamation by means of dredging, or alternative proposals for same.

3. Mr. Kidd's estimate was unaccompanied by details, and I am asked to prepare a revised estimate for the whole of the scheme, giving details showing—

(*a*) cost of dredging plant;
(*b*) cost of dredging;
(*c*) cost of sea wall, along with the price of plant in connection with the same;
(*d*) cost of murum filling and plant required.

I am further asked to prepare a programme of construction, along with an opinion as to the order in which the work should be executed, and the time within which the various sections could be completed, and whether the entire work should be given out as one complete contract or divided up into small contracts, or the whole carried out departmentally.

Lastly, I am to submit a separate report and estimate on the above lines for the reclamation of the east of the Peninsula known as the East Colaba Project, and an opinion as to whether it could be carried out by dredging plant already in Bombay.

4. *History of scheme.*—There have been so many projects for reclamation in Back Bay that I think it will be of assistance and make my report more complete, if I briefly give the history of these, more especially as Mr. Kidd's scheme is an adaptation of previous projects.

5. In 1865 a Company was formed to reclaim 1,500 acres of the foreshore, but owing to financial difficulties caused by the failure of a Banking Corporation in which the Company had deposited 90 lakhs, the Company was voluntarily wound up.

In 1887 the Government of Lord Reay was impressed with the necessity for making provision for the prospective rapid growth of the City, and attention was centred on the possibility of reclaiming land east and west of the Colaba Peninsula. It was proposed to bring material for filling, by train from inland, and the basis of the estimate was a rate

of Rs. 4 per 100 cubic feet or Re. 1-1-3 per cubic yard for this portion of the work.

No action was taken, and in 1897 a Committee was appointed by the Government of Lord Sandhurst to reconsider the matter. This Committee issued a series of reports; in the first, dated April, 1897, they stated that they attached great importance to reclamation along the west side of Colaba Point, and in a subsequent report, dated 15th May, 1897, the Committee reviewed at considerable length the cost of reclamation at Colaba and the probable financial results; they considered 1¼ million square yards should be reclaimed on the west side of Colaba at a cost of 100 lakhs of rupees, including roads, drains, etc., and that of the total area so reclaimed, 1,000,000 square yards would be available for building purposes. The Committee recommended that an accurate survey of Colaba foreshore should be made and they laid stress on the necessity for proceeding tentatively with the scheme. They also recorded the opinion that the line of reclamation adopted should in any case be final so that there should be no possibility of its being thereafter extended and a new frontage formed.

Immediate action was taken on these reports and a detailed survey of the Colaba foreshore was completed by March, 1898.

6. About this time the Bombay Improvement Trust was created, and on the basis of the survey they found it would be practicable to reclaim a total area of 2·5 million square yards, involving filling to the extent of 9·5 million cubic yards, but in pursuance of the policy to proceed tentatively, it was decided, in the first instance, to take in hand the reclamation of a specially selected portion having an area of 90,000 square yards. This work was finished at a cost of Rs. 5,00,000, and the lands reclaimed were readily leased at rentals representing a capital value of upwards of Rs. 24,00,000, but although the work showed a considerable profit, the Improvement Trust had insufficient funds at their disposal to proceed with the larger scheme.

7. In 1904 a Committee, entitled the Military Lands Committee, examined the project with a view to reclaiming lands for military purposes, and contemplated reclamation of very extensive areas in Back Bay and on the Harbour side of Colaba for purely military purposes. No action was, however, taken.

8. In 1905 the Bombay Public Works Department prepared four alternative projects for reclamation to the extent of 2,294 acres, 1,712 acres, 200 acres and 207 acres respectively, and it may be pointed out that for the first time it was proposed to obtain the filling by dredging from the Harbour and pumping through pipe lines across the Peninsula, and tenders to this end were received from several dredging contractors.

9. In 1906 the Bombay Public Works Department drew up a revised scheme for the reclamation of 973 acres in Back Bay and 121 acres on the Harbour side of the Colaba Peninsula, the following being the details of the estimate:—

973 *Acres.*

| | Rs. |
|---|---|
| 24 million cubic yards mud filling at 6 as. ... ... ... | 90,00,000 |
| 1·82 million cubic yards top dressing at Re. 1 ... ... ... | 18,20,000 |
| 8,800 R. feet masonry wall at Rs. 150 R. feet ... ... ... | 13,20,000 |
| 1,650 R. feet pitching at Rs. 60 R. feet ... ... ... ... | 7,00,000 |
| | 1,28,40,000 |
| Roads, lighting, drains, etc. ... ... ... ... ... | 33,00,000 |
| Establishment and contingencies ... ... ... ... | 14,40,000 |
| | 1,75,80,000 |

Or Rs. 3.73 per square yard.

| | Rs. |
|---|---|
| 121 *acres on Harbour side.* | |
| 3·2 million cubic yards mud filling at 5 as. ... ... ... | 10,00,000 |
| ·3 million cubic yards murum dressing at Re. 1 ... ... | 3,00,000 |
| 4,000 R. feet masonry wall at Rs. 150 ... ... ... ... | 6,00,000 |
| | 19,00,000 |
| Roads, drains, lighting ... ... ... ... ... ... | 4,00,000 |
| Establishment and contingencies ... ... .. ... ... | 2,45,000 |
| | 25,45,000 |

Or Rs. 4.35 per square yard.

10. In 1907 the Government of Lord Lamington appointed a Committee, presided over by Sir Walter Hughes, to consider the 973 acre scheme and the Committee was asked to report on—

(*a*) The possibility of the scheme and its utility.

(*b*) The probable financial results.

(*c*) The best method of carrying out the work.

(*d*) The position of the Bombay Improvement Trust in respect to same.

On the question of the utility of the scheme, its financial results, and the position of the Bombay Improvement Trust the Committee were not quite unanimous and several members wrote minutes of dissent. They agreed that reclamation down to sea level (presumably L. W. O. S. T.) offered the best prospect of remunerative return as the expense of the sea wall and of the filling would be considerably reduced, but they considered there would be no finality in such a scheme and it would not adequately provide for the future extensions of the City in the most suitable and one of the only possible directions. Finally they agreed that whatever scheme was adopted the line of the sea wall should be the ultimate one.

11. Lord Lamington left Bombay in 1907 and was succeeded by Sir George Clarke (now Lord Sydenham) and in February, 1908, the firm of Lowther & Co., Civil Engineers and Contractors (subsequently Lowther & Kidd) submitted the outline of a scheme for the reclamation of Back Bay and offered their services. Messrs. Lowther & Co.'s scheme contemplated the reclamation of the whole of Back Bay from Colaba Point to Malabar Point, an area of 3,576 acres at a cost of Rs. 13,28,00,000 or Rs. 7.10 per square yard of land reclaimed, or alternatively the reclamation of 2,945 acres at a cost of Rs. 6.14 per square yard presumably of land reclaimed and exclusive in each case of cost of roads, drains, etc., on reclaimed land. The latter scheme, if adopted, was to be carried out in sections, the first section containing 1,261 acres to cost Rs. 3,66,50,000 or Rs. 6 per square yard, exclusive of roads and drains.

12. On the 16th July, 1909, Messrs. Lowther & Kidd again addressed the Government of Bombay and said they had observed that the Government had issued a Resolution on the subject of the development of Bombay, which, among other things, included a decision to prosecute an adequate scheme for reclamation in Back Bay, and they therefore placed their services at the disposal of Government, to make the necessary surveys and investigations with a view to making definite proposals on a business basis. Apparently their offer was accepted, because, on the 27th October, 1910, Messrs. Lowther & Kidd wrote that in accordance with instructions, they had, after a most careful and exhaustive study, prepared a scheme for the reclamation of Back Bay which they had the honour to submit.

13. They said that they had been provided with all the data in possession of Government requisite for the consideration of the scheme, such as surveys of site, levels of ground, nature of sea bed and extent of material

available for filling, etc., and this they had supplemented by further surveys and an extended examination of the site, including a further series of borings in the harbour, to ascertain the nature and extent of the material available for filling, so that taken together they had ample data for the consideration of the project.

Messrs. Lowther & Kidd's scheme contemplated the enclosure of 1,272 acres as against 973 acres in the Government scheme, and their estimate amounted to Rs. 388¼ lakhs of Rs. 5.80 per square yard of land reclaimed inclusive of cost of roads, lighting and drains, the rate for mud filling being 10 annas per cubic yard and for murum topping Rs. 2.2 per cubic yard.

Messrs. Lowther & Kidd's estimate for the Government scheme of 973 acres was 284.41 lakhs or Rs. 6.04 per square yard of land reclaimed inclusive of roads, lighting and drains, and the price of mud filling was taken at 10½ annas per cubic yard.

14. Messrs. Lowther & Kidd discussed at length the best method of carrying out the scheme, i.e., whether by Government itself or by means of a concession granted to a Company or other similar agency, and further, whether in the first alternative the execution of the work should be undertaken directly by Government or let by contract, and after weighing the *pros* and *cons* they decided that the right plan was for Government to do the work at its own cost and risk through the agency of a firm of Engineers and Contractors. Messrs. Lowther & Kidd accordingly tendered for the work on the basis of Government entrusting its execution to them as their fully empowered agents, and paying a commission for their services of 5 per cent on the cost *plus* a bonus of one-fifth share in any savings effected on the sanctioned estimate.

The report was accompanied by a number of financial statistics in support of their proposals, and by a draft Specification, Conditions of Contract, and Tender for either the 973 acre or 1,272 acre scheme and by a general estimate for each scheme.

15. On the 21st January, 1911, the Secretary to the Government of Bombay addressed the Secretary to the Government of India on the subject, giving the history of the various proposals up to date, and with reference to Messrs. Lowther & Kidd's offer for the 973 acre scheme he remarked that it was 36 lakhs less than the Government's estimate for the same work, and he made the following recommendation:—

> "Detailed plans and estimates will be submitted when the general proposals are approved. For the preparation of designs of the plant and works, and for the execution of the work, Government propose to utilize the services of an Engineer of wide experience of sea works, Mr. Kidd of the firm of Lowther & Kidd, who, as the Government of India are aware, carried out the Government Dockyard works in Bombay, and who has an intimate knowledge of the local conditions. The rates given above have been supplied by him, and he has expressed his willingness to prepare designs and working drawings, to place at the disposal of Government his extensive experience, to procure for Government the special prices at which manufacturers supply plant and materials to contractors, and to carry out the work at an inclusive charge of 5 per cent. on the outlay subject to a maximum of 5 per cent. on the estimate as finally accepted by Government after careful scrutiny. In order to give the firm an interest in carrying out the work as economically as possible Government propose a bonus of one-fifth of the saving that may be achieved. The reclamation will be effected by means of suction dredgers working in the Harbour on the east of Colaba, where the presence of an ample deposit has been ascertained, and delivering the clay at the site of the reclamation—the most efficient and economical method of carrying out reclamation on a large scale. After the clay has settled, a layer of murum, one foot thick, is to be spread over the whole area."

16. In the matter of Messrs. Lowther & Kidd's larger scheme for the reclamation of 1,272 acres he said that sections which had been taken indicated that the best and most profitable scheme would probably be one lying between the two schemes, and having a gross area of about 1,100 acres; that it was unnecessary at that time to prepare a detailed project, but immediately on receipt of the general approval of the Government of India, and of the Secretary of State, to the proposals submitted, Government would cause the necessary surveys to be undertaken and estimates to be prepared when the whole question would be thoroughly re-examined from a financial point of view, and the most promising scheme submitted to the Government of India.

Meanwhile enough had been said to show that a scheme of reclamation would not only provide for an urgent need of the City of Bombay, but would also prove a sound financial undertaking of the nature of a Productive Public Work which Government regarded with great confidence. The Government of India was therefore requested to be good enough to submit the proposals to the Secretary of State for his general approval, as the Governor in Council was anxious the actual work should be commenced with the least possible delay.

17. The Government of India replied on the 14th October, 1911, and said that before any representations could be made to the Secretary of State they must be satisfied that the works would be reproductive, and for that purpose there was practially no data available. The Government of India did not wish to question the accuracy of the skilled Engineers who had advised the Government of Bombay, but their figures had not been placed before the Government of India, and all that could be said on a general review of the case was that large estimates of that type were particularly liable to be exceeded, and that even in Bombay experience of that type of reclamation on an open sea front was limited. On the proposal that the scheme, if undertaken, should be executed by Government in preference to private agency, the Government of India were not convinced, on the information before them, that the scheme, if undertaken, should be executed by Government in preference to private agency, and asked that the matter should be further investigated, and finally they enquired what would be the cost of the detailed surveys and estimates which would be necessary before the scheme could be recommended to the Secretary of State.

18. The Government of Bombay again addressed the Government of India on 6th December, 1911, and the following extracts from their letter are of interest:—

> "In the first place I am to point out that no final scheme has been put forward at this stage for the acceptance by the Government of India or the Secretary of State. The two tentative schemes were explained with the object of proving that the reasons for believing that the work would be reproductive were sufficiently strong to justify expenditure on the more detailed investigation required for the preparation of a complete project.
>
> "These reasons were fully set forth in Mr. Cameron's letter to No. C.W.-133 dated the 21st January, 1911, but I am again to refer briefly to them here. The cost of the execution of a reclamation was first estimated by the officers of the Public Works Department, and the estimate thus obtained showed that the prospect of financial success was most promising. The Governor in Council felt, however, that complete reliance could not be placed on these figures, as no officer of the Department had practical experience of work of this highly special nature. Mr. Kidd, a partner in the firm of Messrs. Lowther & Kidd, who possessed all the experience and knowledge required, and who was then in Bombay in connection with the extension of the Government Dockyard which was being carried out by his firm, was struck by the exceptional opportunity afforded by the

stretch of rocky foreshore visible at low tide and offered to make a preliminary investigation of a project for reclamation at his own expense. This offer was accepted by the Government of Bombay, as it afforded the best means of testing the estimates of their own officers, while it involved no obligation to employ Mr. Kidd's firm for the execution of the work. The figures supplied by him confirmed those obtained by the officers of the Public Works Department. Provision was made in both estimates for all contingencies that could be foreseen and a large margin was provided for unforeseen contingencies. In Mr. Porter's letter under reply, it is stated that experience of reclamation by suction dredging is "limited" in Bombay. I am, therefore, to point out that the large reclamations being carried out by the Port Trust afford exceptionally complete data for estimating work of this kind.

"The Government of Bombay are satisfied that Mr. Kidd's figures may be accepted with safety as a sufficiently close approximation to the cost of the work to justify the further investigation of the scheme, and they clearly indicate that the scheme may be expected to be productive. Mr. Kidd's detailed estimates could not be supplied to the Government of India, as they are not officially in the possession of the Government of Bombay, but an abstract estimate was so supplied. The Governor in Council has closely examined the figures and is convinced that they have been drawn up with due care and are sufficient for the immediate purpose in view, namely, to show that the reclamation scheme will be a reproductive public work, and as such deserves detailed investigation.

"The Government of Bombay being thus convinced that the scheme would be highly productive, laid before the Government of India their initial proposal that the scheme should now be examined in detail and that complete estimates of the cost of execution should be carefully prepared. Their second proposal at this stage dealt with this investigation and the preparation of the estimates.

"They proposed that this work should be entrusted to Mr. Kidd and that his firm should eventually carry out the project for Government on the terms laid down in paragraph 14 of Mr. Cameron's letter. Mr. Kidd has special knowledge and experience of this class of work, and has, in addition, close acquaintance with local conditions owing to the work lately carried out by his firm in Bombay, the arrangements made for carrying out which work compared very favourably with those made on other large works in progress in Bombay. Further, the preliminary terms offered by him appeared to be very favourable to Government. If the investigation and the preparation of the estimates are to be entrusted to a firm of contractors, it appears necessary that they should carry out the work of reclamation in the event of its being approved; but it was not intended that their estimates should be accepted without careful scrutiny on the spot by an independent expert if such a person can be obtained.

"An alternative method of procedure is to employ an expert for the investigation and the preparation of the estimates, and to call for tenders for the execution. This alternative did not commend itself to Government, because it would not provide so satisfactorily for their control of the work. Further, Government are well aware that economy in this class of work can be attained only by securing that the suction dredgers and other plant required shall be of the best design. The difficulties which have arisen with the Port Trust dredgers serve as a warning on this point. It is also necessary that most careful consideration should be given to the arrangements for carrying out the work and to the order in which it must be undertaken, and this is more properly the work of the contractor than of a Consulting Engineer."

19. Messrs. Lowther & Kidd were then asked to state their terms for making a complete survey, accompanied by plans and estimates for the work, and on the 30th November, 1912, the firm replied, stating that although they had no reason to doubt the substantial accuracy of the information on which the preliminary schemes dealt with in their report on the 27th October, 1910, had been based, they agreed that, having regard to the great extent and importance of the scheme, it seemed very desirable, and, indeed, most necessary, that the data upon which a definite and final scheme was to be formulated should be much more extensive, and they offered to execute and complete a detailed survey and investigation of the site, together with other engineering matters which entered into the scheme, and to provide, complete and detailed drawings and estimates based on such survey for a professional fee of Rs. 75,000 *plus* estimated cost of survey, drawing, etc., Rs. 82,500, making a total of Rs. 1,57,500. They further stated that on payment of the fees the whole of the data, plans and estimates were to become the sole and absolute property of the Government who were thenceforth to be at liberty to make any use of such information—including that already supplied by them—as Government thought fit.

Finally, they remarked that their principal aim, in the event of the execution of the work being proceeded with, would be to undertake such execution in terms of the proposals to Government dated 27th October, 1910, and they suggested that Government should pay the fee of Rs. 75,000 for professional services on the express conditions that should the execution of the work be subsequently entrusted to them, this sum would revert to Government and become merged in, and treated as part of, the sums to be paid them as commission for executing the work, providing the plans, etc.

20. The terms were in due course approved by the Government of India and the work put in hand, and on the 3rd August, 1912, Messrs. Lowther & Kidd submitted the report known as " Project of 1912 " accompanied by plans and estimates.

The total area to be reclaimed under this latest scheme was 1,145 acres in Back Bay and 123·93 acres on the eastern side of the Colaba Peninsula. The estimate for Back Bay came to Rs. 325·23 lakhs or Rs. 5·86 per square yard of reclamation, and for eastern Colaba Rs. 37·25 lakhs, being a total of Rs. 362·48 lakhs for 1,268·93 acres.

At the same time Messrs. Lowther & Kidd offered to carry out the work on the basis of Government entrusting its execution to them as their agents, paying a commission for their services of 5 per cent. on the amount of an estimate agreed jointly between the Government and themselves and a bonus of one-fifth share on any saving effected.

21. On the 7th August, 1912, the Government of Bombay forwarded, for the consideration of the Government of India, the report submitted by Messrs. Lowther & Kidd, and observed that the drawings might be considered as complete working drawings, which would give sufficient information for examination of the designs and for the immediate commencement of the work; the investigation had been most carefully made and might be accepted as exhaustive, the report was clear and complete, all doubtful points had been settled, and the revised estimate might be accepted as completely trustworthy and ample, provided that the arrangements proposed for the execution of the work were adopted. Finally, it was stated that it was the earnest desire of His Excellency the Governor in Council that the project should receive the serious consideration of the Government of India as a highly productive public work, and that it might be recommended as such to the Secretary of State; the opinion was also expressed that the arrangement proposed by His Excellency for the execution of the work was the only arrangement which would ensure the efficiency and economy essential for the success of the scheme.

22. On the 13th November, 1912, the Government of Bombay appointed a Committee of prominent and representative citizens to investigate the financial features of the scheme, and to answer a series of questions dealing with the need of the reclamation, the probable demand for building sites, the effect upon the value of existing landed property in Bombay and other important matters.

This Committee reported on the 22nd January, 1913, and concluded their remarks by saying that they wished to lay stress on the fact that the scheme was not only financially sound, but that it added to the beauty of the City and would, after some years, add considerably to the resources at the disposal of the Improvement Trust in its efforts to reclaim insanitary areas.

23. On the 11th March, 1913, the Government of Bombay again addressed the Government of India on the subject, and after recapitulating briefly the steps which had been taken and quoting the findings of the recent Committee urged that sanction should be accorded to the work, and that either the Government of Bombay should be empowered to raise the successive annual loans required, acting as agents for the Government of India in the matter, but accepting the risk; or that the Government of India would provide the necessary sums as in the case of other productive works.

24. The Government of India were, however, still unconvinced, and expressed the opinion that a strong representative Committee should be invoked, to consider the future development of Bombay City in all its bearings, and that if the Committee were in favour of the Back Bay Scheme, a beginning should be made with a strip of land measuring 84 acres, at an estimated cost of Rs. 37 lakhs, when the validity of the estimate and the demand for land would be tested by this experiment.

The Bombay Development Committee was accordingly appointed by Government of Bombay Resolutions dated October and November, 1913, and their report was issued in April, 1914.

The report contained no specific recommendation to undertake reclamation in Back Bay on a large scale, but suggested that an area of 100 acres should be reclaimed in order to provide accommodation for certain urgently required public buildings.

25. Meanwhile, Mr. Kidd had, in July, 1913, submitted a proposal to spread the work over a period of 24 years and to divide the reclamation into sections, and he made an offer to carry out the first section of 84 acres for the sum of Rs. 37,18,060, the work to be completed in 3½ years.

The price of pumped filling was increased to annas 11·3 per cubic yard and the contractors' commission to 6¼ per cent. with a bonus of ¼ on any savings effected on the estimate.

In November, 1913, Mr. Kidd submitted an alternative tender for the reclamation of 900 acres, and in October, 1914, a proposal to reclaim 220 acres.

Mr. Kidd's further proposals were sent to the Government of India by the Government of Bombay in September, 1916, with a recommendation that the 220 acre scheme be approved, as the Government and Council did not consider the 84 acre plot would meet immediate requirements.

26. The Government of India replied in February, 1917, and pointed out that the 220 acre scheme was not in accordance with the decision arrived at in 1913, and they regretted they were unable to entertain the proposal, but if the Government of Bombay should submit a more modest scheme, on the lines proposed by the Development Committee and could satisfy the Government of India that it could be worked from Provincial resources, they would be prepared to give such a scheme their careful consideration.

27. The matter then dropped until 1918, when a local syndicate addressed the Government of Bombay, and asked for a concession to reclaim Back Bay, as they proposed to float a company with the necessary capital, and to carry out the work according to the programme of Messrs. Lowther, Kidd & Co.

In January, 1919, Mr. Kidd, who had meanwhile left the firm of Lowther & Kidd and become attached to Sir William Armstrong, Whitworth & Co., made an offer on behalf of that firm to reclaim a gross area of 350 acres, but at greatly enhanced rates, the prices for mud filling being increased to Rs. 4 per cubic yard and murum backing to Rs. 3·8 per cubic yard.

Finally the Government of Bombay decided to obtain a further report by an independent expert on the whole scheme.

28. I will now deal with the various points in the terms of reference, but in this connection I would point out that the absence of details in Mr. Kidd's plans and estimates makes it very difficult for me to report on his scheme so fully as I should like to do, or to examine his figures of cost from a technical point of view.

It is usual when preparing estimates for a project of this magnitude, and especially when the estimates are those on which the authorities are asked to sanction the execution of the work, for all details to be furnished, but in this case details are left to imagination.

The item Dredging accounts for Rs. 139·69 lakhs out of a total of Rs. 325·23 lakhs but no particulars are given as to the capital cost of the dredger, the size, length and cost of the pipe lines and the cost of working the dredger. Item for Sea Walling accounts for Rs. 65 lakhs, but there are neither quantities nor prices for concrete masonry work, concrete block work, foundation work, etc., and although it is stated that for the deep and important part of the sea wall provision has been made for the execution of the work within a dam of a special form of construction adapted to the conditions of sea exposure, depth of water and a rock bottom, no particulars of the dam are given. Item Murum in Backing accounts for Rs. 45·52 lakhs, and all the information given is that estimates are based on a site at the north end of Trombay Hill, and that provision has been made for getting and filling the murum by American steam shovels and filling the material into private wagons of a special type of high capacity. Under these circumstances I have had to go into the matter *ab initio* and prepare my own designs and estimates.

### Practicability of the Scheme from an Engineering Point of View.

29. There can be no doubt that for the following reasons the scheme is practicable:—

(1) The conditions of the site lend themselves to a reclamation scheme and the natural beauty of the Bay will not be impaired.

(2) There is an abundance of material in the Harbour for the filling and it can be deposited in the area to be reclaimed by means of modern suction dredgers much cheaper than in any other way.

(3) The fact that the dredgings will be deposited in the first instance on the inside of the area to be reclaimed and thence pushed forward to the outside retaining wall is advantageous, as the soft mud will form the bottom layer of filling and the hard clay which lies below the mud over the area to be dredged will be superimposed on the mud.

In the case of the Sewree Reclamation carried out by the Bombay Port Trust, the reverse was the case, as the filling began on the outside of the area and was gradually advanced to the line of foreshore.

(4) As nearly the whole of the area to be reclaimed has a rock bottom, there will be no material wasted through compression of the ground reclaimed. Moreover, it will not be necessary to wait several years for the reclaimed land to solidify before beginning building operations, as the foundations can in each case be taken down to the rock.

SUITABILITY OF THE TYPE OF WALL PROPOSED OR ALTERNATIVE SUGGESTIONS FOR BETTER TYPES.

30. A great deal has been said about the necessity for a substantial sea wall to resist the action of the sea waves during the monsoon. The 1906 project contemplated a pitched slope, but this was overruled by the 1907 Committee, who insisted on a solid wall. Messrs. Lowther & Kidd proposed a solid upright concrete wall built on the basalt rock for the lengths exposed to heavy sea attack, and a rubble stone embankment protected with 20-ton concrete blocks thrown on the seaward slope, for that portion of the wall founded on the sand overlying the hard bottom.

The total length of solid sea wall in Messrs. Lowther & Kidd's scheme is 9,300 feet, at prices varying from Rs. 465 to Rs. 207 per lineal foot, and the length of rubble embanking 12,924 lineal feet, at Rs. 207½ per lineal foot, or, to put it in another way, the solid wall is estimated to cost Rs. 37·40 lakhs and the rubble slope Rs. 26·82 lakhs.

In paragraph 10 of their report, Messrs. Lowther & Kidd observe that beyond the line of the sea wall there lies, in the direction of the heaviest sea attack, a succession of detached outlying reefs, which have great effect in reducing the force of the sea along the line of the proposed wall. They say they repeatedly observed at the time of low water that, while a very strong ground swell was breaking heavily on the reefs, the water on or adjacent to the line of the wall was perfectly smooth, and although at high water a considerable amount of sea run over the tops of the reefs, their effect in reducing the heaviest results of the attack was very important.

Under these circumstances they were satisfied that as compared with many defence walls within their knowledge in different parts of the world the sea attack in this case would be moderate.

31. In my judgment the sea attack will be nearly, if not quite, as severe on the portion of the wall formed by a rubble bank as against the portion where the solid wall is to be built. Moreover, the solid wall as proposed by Mr. Kidd would be very difficult and very costly to build, and would take a number of years to complete.

Under these circumstances I have consulted my partner, Mr. C. S. Meik, whose name was mentioned in the letter from the Government of Bombay to the Government of India, dated 7th August, 1912, as "the eminent Consulting Engineer whose opinion on sea protection works may be accepted with confidence," and he and I are of opinion that the solid sea wall may be discarded and a stone rubble embankment, protected on the sea side by 20-ton concrete blocks, may be constructed for the entire length, with the exception of some 2,500 feet from Colaba Point, where the rock foundation is so far above low water that an ordinary concrete wall will be more suitable.

The sections of the wall as proposed by me are shown on plan No. 2 accompanying this report, and the saving in time and money over Messrs. Lowther & Kidd's scheme will be considerable. The wall I propose consists of a rubble embankment 17 feet wide at low water mark, with a 2 to 1 slope on the sea side and 1 to 1½ on the land side, surmounted by a concrete or masonry retaining wall having a coping level of 98·00 and pitched on the sea side of the slope with 20-ton blocks of concrete.

32. The procedure of construction would be as follows:—

(1) A suitable quarry to be opened up as near as possible to one of the railways, and preferably the B. B. and C. I. Railway.

(2) A timber staging to be built in sections along the whole line of the wall, the staging to be wide enough and strong enough to carry a line of railway and a 20-ton crane.

(3) Special 40-ton bogie wagons, bottom and side discharging, to be purchased in sufficient number to provide two trains per diem.

(4) All stone to be loaded into the wagons at the quarry. The wagons to be hauled to the site of the work by the Railway Company and thereafter tipped on the line of the wall.

(5) Concrete blocks to be set in position by the crane.

The work is thus reduced to simplicity. There are no coffer dams to make, and no tide work, and construction can proceed irrespective of the state of the tide and to a certain extent throughout the monsoon. I estimate that with a quarry capable of putting out 800 tons per diem it will be possible to finish the whole wall in four years if required. The staging will also serve for the deposit of all the murum backing behind the wall and a certain amount of topping, and the same railway wagons can be used both for the quarrying and the murum filling.

33. In the matter of the quarry, Mr. Kidd in his report stated that the whole of the stone required would be obtained from a quarry which would be opened within the site of the reclamation as an opportunity had been taken of satisfying themselves that the stone available was of the best possible quality; the quarry would therefore enable an important economy to be effected in the cost of the works. When in Bombay in the month of May, 1919, I inspected the site of the proposed quarry in company with Mr. R. J. Kent, the Joint Secretary, Public Works Department. We saw a large number of boulders on the sea shore that could probably be removed and broken up, but I think we were both satisfied that nothing in the shape of a quarry was possible in the locality.

### Suitability of the Proposed Method of Reclamation by Means of Dredging or alternative proposals for same.

34. The proposal to obtain the material for filling by dredging in the Harbour, and pumping across the Colaba Peninsula, was first considered in 1905 and prices were received from several contractors, the rates varying from six to seven annas per cubic yard. Mr. Kidd has adopted the same method, which is indeed the only way of getting the work done at a sufficiently low rate to make the scheme practicable from the financial point of view.

Paragraphs 5 to 8 of Mr. Kidd's report are devoted to an analysis of the material in the Harbour and the quantity available for dredging purposes, and Mr. Kidd says it has been completely established that there is available more than three times the quantity required of suitable material.

On the assumption that Mr. Kidd's surveys and borings are correct, and I see no reason to doubt their accuracy as a great many borings were taken, I accept his conclusion both in respect to quality and quantity of material.

35. Paragraphs 22 and 23 of the report discuss generally the dredging plant, but as I have already pointed out, no details are given, and as the provision of efficient dredging plant constitutes the crux of the whole scheme the omission is unfortunate.

I am unable to agree with Mr. Kidd that the great progress in the developments of suction dredging machinery has been achieved mostly in the United States and Canada and that in England machinery and methods are backward and inefficient.

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My own experience is exactly the reverse as some years ago I made a tour of the United States and Canada and after seeing the principal dredgers in both countries I decided they were very inferior to our home manufacture.

36. I am also unable to concur in Mr. Kidd's remarks on the subject of power to be employed for operating the machinery, as I think the adoption of the Diesel or similar type of internal combustion engine would be a risky experiment at the present time.

Mr. Kidd's reasons against the employment of electric power on the main dredger apply with equal force to the internal combustion engine which although highly efficient when running under ideal conditions of steady load speed and long periods without stoppage are not at present, whatever they may be in the future, designed to stand the heavy and frequent overloads that re-act through the pump and the sudden stoppages that are liable to occur through the fouling of the impeller by obstruction. There would also be a difficulty in maintaining a sufficiency of air supplied when frequently starting under load.

37. I will now describe the plant that I recommended after discussion with my partner (Mr. Meik) and with Messrs. W. Simons & Co., the well-known designers and builders of dredging machinery who have specialized in this particular class of plant.

The essential requirements of the plant are that the material should be dredged to depths up to 70 feet below water level at the rate of 2,000 cubic yards per hour and discharged through 10,000 to 12,000 feet of pipe line on to the land to be reclaimed.

It is not practicable for the pump on the dredger to discharge without assistance through such a long length of pipe, and I therefore propose that the dredger pump should take the material 5,000 feet and an intermediate stage pumping station do the rest of the work; this is the usual procedure with long pipe lines, and by increasing the number of intermediate pumping stations there would be no difficulty in discharging any distance.

From Mr. Kidd's plans I see he proposes seven pipe lines across the peninsula. I think this number is excessive and have reduced the number to three.

The dredger would be worked by steam power generated by oil fuel, but the intermediate pumping station would be worked by electric current supplied from public supply.

The size of the suction pipe on the dredger would be 39 inches and the discharge pipe 42 inches: the 5,000 feet of floating pipe line resting on tubular pontoons.

The plant has been designed to deal with 25 million cubic yards in five years, working 170 days a year and 15 hours' actual pumping a day, in two shifts.

This is a conservative estimate and based on the possibilities of the dredger being unable to work through any part of the monsoon. I have also prepared an alternative estimate for a smaller dredger to take seven years over the work, but this increases the working cost.

Appended to this report are plans, specifications and tenders for the dredging plant by Messrs. Simons & Co.; also an analysis I have prepared of the working cost of both types of dredgers under various conditions.

### Estimates.

38. *Table A shows* Mr. Kidd's estimate of the cost of the work in 1912 compared with my estimate of the cost of Mr. Kidd's scheme if it had been carried out at that date.

*Table B shows*—My estimate of the cost of the work at the present time if carried out according to my designs.

*(Appended to the report is a statement giving details of estimate in Table B.)*

TABLE A.

| Item. | Description. | Quantity. | Mr. Kidd's estimate, 1912. | | Sir G. Buchanan's estimate, 1912. | |
|---|---|---|---|---|---|---|
| | | | Rate. | Lakhs. | Rate. | Lakhs. |
| | | | Rs. a. p. | | Rs. a. | |
| 1 | Pumped filling, cubic yards | 24,162,463 | 0 9 3 | 139·69 | 0 5 | 75·50 |
| 2 | Murum in backing to sea wall cross bank and covers over pumped filling, cubic yards. | 2,600,815 | 1 12 0 | 45·52 | 1 8 | 39·00 |
| 3 | Sea wall, lineal feet ... | 22,224 | 288 15 0 | 64·22 | 252 0 | 56·00 |
| 4 | Railing to sea wall ... | 22,224 | 3 14 0 | ·86 | — | ·44 |
| 5 | Roads, lighting and drains, Public Works Department. | — | — | 250·29 | — | 170·94 |
| | | | | 59·45 | — | 59·45 |
| | | | | 309·74 | | 230·39 |
| 6 | Engineer and Contractors' commission. | 5 % | | 15·19 | | 11·51 |
| | | | | 325·23 | | 241·90 |

TABLE B.

*Sir G. Buchanan's Estimate*, 1919.

| Item. | Description. | Quantity. | Rate. | Amount. |
|---|---|---|---|---|
| | | | | Lakhs. |
| 1 | Pumped filling ... ... cubic yards | 25 million | 8 | 125·00 |
| 2 | Murum backing and topping cubic yards | 1,919,000 | 2 | 38·39 |
| 2A | Stone in murum bank ... ... ... | — | — | 3·13 |
| 3 | Sea wall ... ... ... lineal feet | 22,224 | 531·4 | 118·11 |
| | | | | 284·63 |
| 4 | Roads, lighting and drainage ... ... | Lump sum. | | 75·00 |
| | | | | 359·63 |
| 5 | Engineering and management, inclusive of establishment and all other charges. | 5 % | | 17·98 |
| | | | Total | 377·61 |
| | Allow for value of plant on completion of work. | | | 10·00 |
| | | | | 367·61 |

39. With reference to Mr. Kidd's estimate of 1912, amounting to 325.23 lakhs, I have not had access to the data on which he prepared the estimate, but I am satisfied the work could have been carried out for my revised figure of 241.90 lakhs.

The principal difference between us is the rate for pumped filling: Mr. Kidd's price being 9 annas 3 pies per cubic yard compared with my rate of 5 annas, which is based on actuals for that class of work.

It is not clear from Mr. Kidd's estimate whether he has allowed anything for value of plant at the end of the job, but as he may have included it in his rates I have done the same, although it is better to state the sum separately as in my estimate, Table B.

With reference to my estimate of the cost of the work at the present time, I have gone into the matter very thoroughly and I believe my figures to be reasonable and reliable. As a matter of principle I never over-estimate an estimate because, although by so doing an engineer may get the credit for not exceeding his estimate, such a practice is not conducive to economical work, and I prefer to make a fair estimate on the data before me, and try to keep within that amount.

### Method of Carrying Out the Work.

40. Messrs. Lowther & Kidd have signified their willingness to undertake the work, as Engineers and Contractors, on the basis of Government contractors, entrusting its execution to them as their agents and paying a commission for their services of 5 per cent. on the amount of an estimate agreed upon jointly between Government and themselves. They further proposed that they should receive one-fifth share in any savings effected in order to make it their interest to attain the most economical result.

Prior to the war this method of carrying out public works was practically unknown outside South American Republics, but during the war it became very popular, because works of military or naval importance were required in a hurry regardless of cost, and not only was there no time to take in tenders in the usual way, but there was also a shortage of engineering staff to prepare the necessary plans and estimates.

It is certainly not the most economical method of carrying out works, nor can I even subscribe to Mr. Kidd's statement that there would be a large saving in the cost of plant because contractors can buy plant and material at prices not attainable by any corporate body. Contractors frequently have a large stock of plant of their own which is moved from job to job; they have also facilities for picking up second-hand plant, but they cannot purchase a large new dredger, for example, at any less cost than would be supplied to Government direct.

41. The usual and best method of carrying out a large public work is to follow one of three courses:—

(1) Tenders to be invited for the execution of the whole work on working drawings, specifications, bills of quantities and conditions of contract supplied by the Engineers entrusted by Government with the project.

(2) The work to be divided into sections and tenders to be invited for each section on the above lines.

(3) The work to be carried out departmentally on working drawings, specifications and estimates prepared by the Engineers entrusted by Government with the work.

42. In the cases of the Rangoon River Training Works, for which I was the Engineer-in-Chief, the Port Commissioners decided on my recommendation to carry out the work departmentally. The work was of considerable magnitude and in many aspects unique, and I felt certain

that any contractor of substance and repute would be obliged to put on to his tender a large sum for contingencies.

The Engineer's sanctioned estimate was Rs. 150 lakhs, and the work was carried out for Rs. 125 lakhs, but I am confident that no contractor would have tendered under Rs. 250 lakhs and probably a great deal more.

I understand that in the case of the Sewree Reclamation works, carried out by the Bombay Port Trust, the work was carried out departmentally at a total sum very much below the lowest tender received, which was that of Messrs. Lowther & Kidd.

43. The Back Bay Reclamation Scheme is a straightforward project, without any of the difficulties that attended the Rangoon Scheme, and if I thought they were any contractors who possessed adequate dredging plant, I should recommend tenders to be taken for the whole work. I know, however, that there is no dredger yet built which is suitable for the work and new plant must be obtained, and in that case I recommend one of two courses:—

(1) (*a*) Tenders to be asked for the construction of the sea wall and a contract placed if a satisfactory offer is received.

(*b*) Tenders to be also asked for the murum filling and construction of roads, drains, etc., and either one contract or several smaller contracts to be arranged.

(*c*) The Government to purchase the dredging plant and carry out departmentally the work of filling the area to be reclaimed.

(2) The whole of the work to be carried out departmentally, making use of local contractors for small contracts.

I am in favour of the first course if a suitable tender is received for the construction of the wall, and in any case I should recommend the preparation of working drawings, specifications and bills of quantities and the consideration of the tenders received, before thinking of doing the whole work departmentally.

44. Lastly, I strongly recommend the employment, as Resident Engineer, of a specialist in sea works and dredging, and with all deference to the Public Works Department I believe the Chief Engineers will be the first to admit that in a work of this nature, more especially in respect to the dredging, the Department has no specialists.

### Time for Completion.

45. There has been considerable discussion as to the speed with which the work should be executed. The Joint Secretary to the Government of Bombay, when forwarding to the Government of India Messrs. Lowther & Kidd's Scheme in August, 1912, stated that the estimate was based upon the assumption that the work of reclamation would give the minimum cost exclusive of considerations of accruing interest charges and that it was assumed the works would be spread over 8 years which would undoubtedly be the most economical arrangement if the whole of the building land could be disposed of as it became available but that it might be found more economical to carry out the work in sections so as to provide successive areas of reclaimed land more or less at intervals for leasing.

In a subsequent letter dated September, 1916, it was proposed to adopt the policy to complete a definite section of the reclamation and, while the land just obtained was being disposed of, to proceed with the remaining sections at a slower rate of progress and to aim at completing the whole work in 24 years, thus avoiding payment of interest charges on the capital involved in the whole scheme until there was some certainty of the disposal of the whole of the land.

46. For the following reasons I doubt very much whether the proposal to spread the work over 24 years is economical:—

(*a*) The initial cost of dredging plant and other temporary works and plant will probably amount to nearly 100 lakhs of rupees and interest is to be paid on that capital whether the plant is being used or not.

(*b*) It is impossible to do the dredging economically if the work is not continuous, and if the dredger is to be laid up for several years after the completion of each section the crew would have to be disbanded and the specialist discharged and sent home just as the plant had attained its highest efficiency.

(*c*) The sooner the work is finished the sooner the dredger and other plant can be sold or put to other remunerative work.

In my judgment the correct and most economical policy is to complete the whole work at the earliest possible date rather than allow valuable plant and skilled men to stand idle and I have views as to the future disposal of the plant which I shall be glad to discuss with Government.

I have divided the work into 4 sections, and on the assumption that the sanction was given on say the 1st January, 1920, I estimate that the work should be completed by the following dates.—

| | *Acres.* | *Dates.* |
|---|---|---|
| Section No. 1 ... ... ... | 354 | February, 1923. |
| ,, No. 2 ... ... ... | 289½ | June, 1924. |
| ,, No. 3 ... ... ... | 297½ | May, 1925. |
| ,, No. 4 ... ... ... | 204 | December, 1926. |

PROGRAMME OF CONSTRUCTION.

47. If my proposals as to method of carrying out the work and time for completion are approved, the programme of construction would be as follows and in the order given:—

(1) Order dredging plant.
(2) Order railway tip wagons.
(3) Open up quarries for stone and murum.
(4) Begin building of wall from the Colaba end.

If the construction of the wall were let by contract, items (2) and (3) would be done by the contractor but that would not affect the order in which the work should be done, and by the time the quarries were opened out and the work of building the first section of the wall well in hand the dredging plant would have arrived and be in course of erection.

The work would then proceed simultaneously under all heads, and on the completion of the work as far as No. 1 Murum Bank that section could be filled in and sections 2, 3 and 4 would follow.

During the monsoon the scar end of the wall would require protection and the work would probably suffer some delay but I can see nothing to prevent the whole wall being completed in 4 years, the filling in 6 years, and the entire area made available for use in, say, 8 years from the date of the order to begin operations.

48. The following plans and documents are attached to this report, viz:—

(1) Drawings Nos. 1 to 6 inclusive.
(2) Plan, specification and tender for dredging plant.
(3) Statement of working cost of dredger.
(4) Detailed estimate for the whole work.

I have the honour to be,
Sir,
Your most obedient servant,
GEO. C. BUCHANAN.

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on 01 February, 2020